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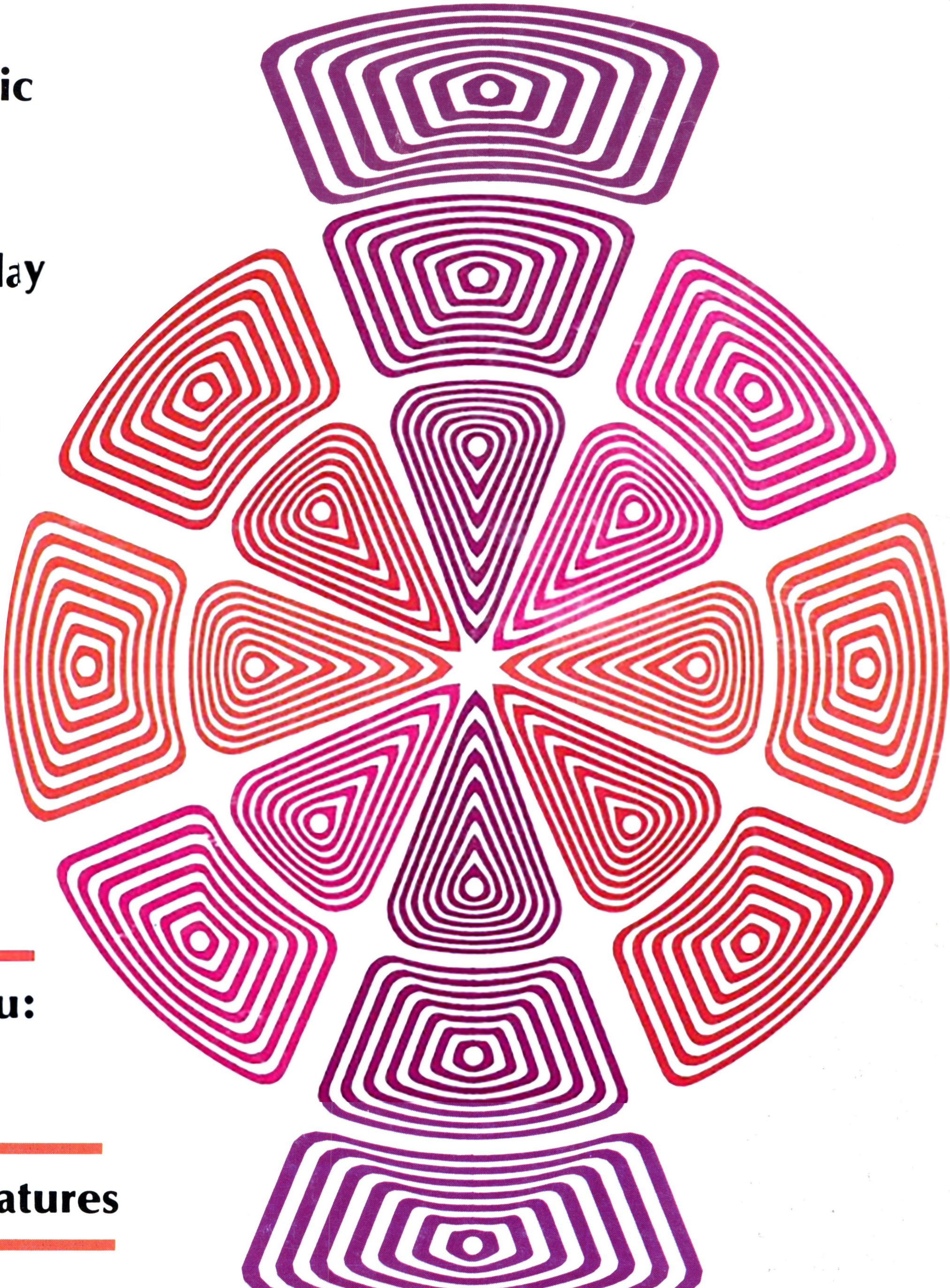

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10 LET A=5
20 LET C=6
30 LET S$="TEST"
40 OPEN #1, TEST.DAT
50 WRITE #1,A,C,S$
60 CLOSE #1
70 REM This program creates a file named TEST.DAT
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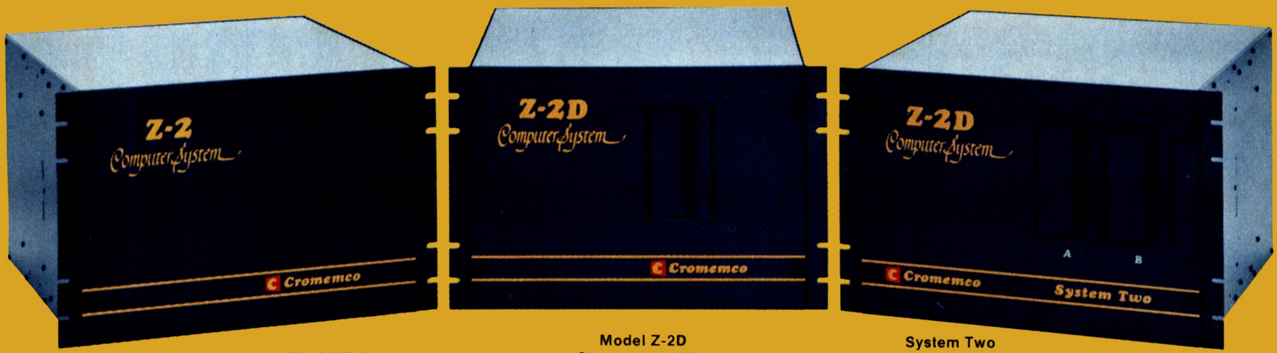

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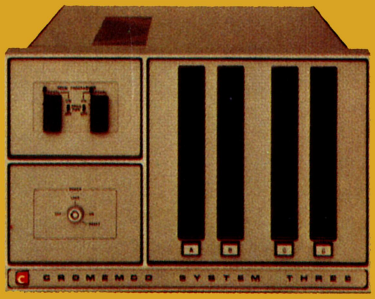

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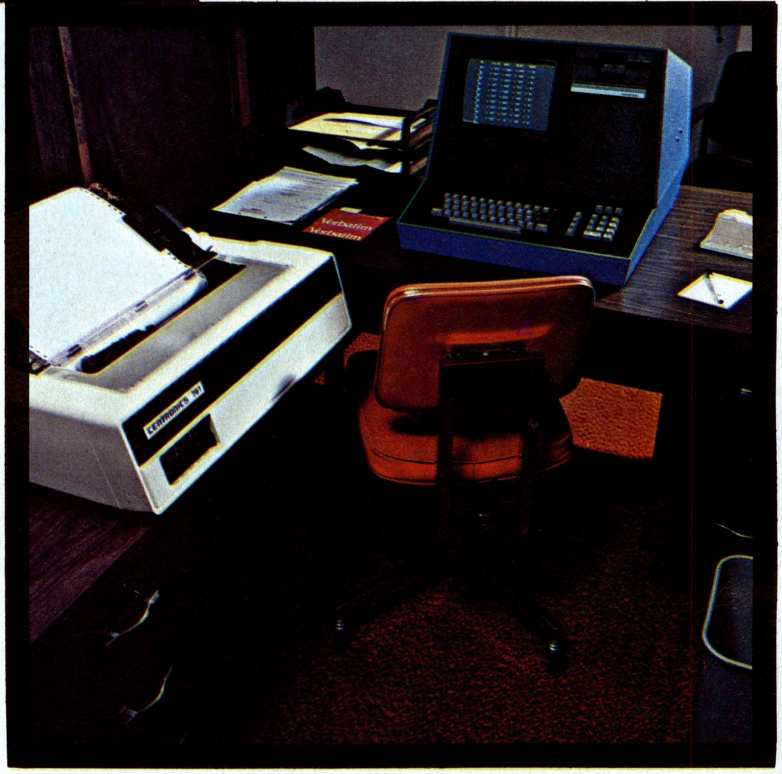

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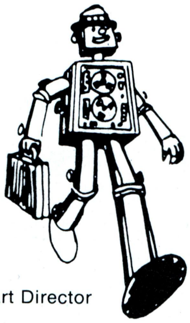

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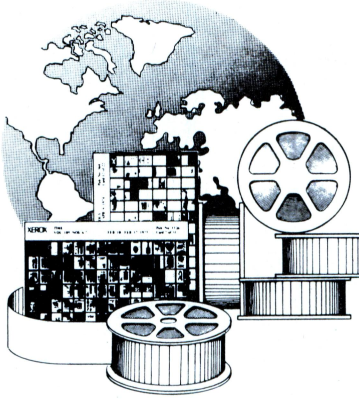

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The Second Annual National ACM/UPE Student Programming Championship was held Wednesday, Feb. 22, 1978 in connection with the Computer Science Conference at the Plaza Hotel in Detroit, Michigan. This championship contest consisted of 24 teams of four student programmers competing to program the solution of four problems in the minimal time and using the fewest number of computer runs. The national championship team is Massachusetts Institute of Technology whose team members are Abe Lederman, Larry Demar, Curt Sanford and Dan DeRamo. The second place went to New York University, with Michigan State as the third place winner and Purdue University taking fourth place.

The teams were given four problems to solve using ANSI. FORTRAN. These problems included integer addition of up to forty digits, the simulation of a virtual brick wall to determine the number of bricks of various types that would be needed in its construction, the determination of a security code algorithm with check digits, and the simulation of a knight's tour on a chessboard. The winners were determined by penalty points for the number of runs and the elapsed time taken for the completion of each problem.

The Third National Student Programming Championship will take place in Dayton, Ohio in connection with the 1979 Computer Science Conference. The 1979 Programming Championship will be coordinated by John Metzner, Computer Science Department, The University of Missouri at Rolla, Rolla, Missouri 65401. Regional qualifying contests are again planned for the Fall '78 in which all interested students are encouraged to participate. These contests will be coordinated through the regional representatives who should be contacted concerning respective plans for each region.

Publication Frequency

You may have noticed on some recent *Creative Computing* subscription notices the price of $15 for 12 issues. This reflects the fact that early in 1979, *Creative Computing* will move to a **monthly frequency.**

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Computer Literacy

A two-year study of Computer Literacy is being conducted by the Minnesota Educational Computing Consortium (MECC) under a grant from the education division of the National Science Foundation. It is intended that the study results will provide valuable information regarding the ways elementary and secondary teachers are using computers, or teaching about computers, in their classrooms. The effects of these various ways upon student knowledge of, attitudes toward, and ability to use computers are of particular interest. As a result of the study, computer literacy instructional materials and measurement instruments will be developed.

To aid in the development of computer literacy materials and tests, it would be helpful if persons who are doing work in the computer literacy area would send sample course/unit descriptions, objectives, curriculum materials and measurement instruments to the Computer Literacy Project, MECC, 2520 Broadway Drive, St. Paul, MN 55113 (1-612-376-1145). For further information contact Dan Klassen or Tom Hansen at the above address.

APL79 Conference

A conference devoted to all aspects of the programming language APL will be held in Rochester, N.Y., **May 30-June 1, 1979.**

APL79 is seeking papers in the traditional areas, such as APL applications, language features, implementations, and system issues. In addition, papers that put various aspects of APL in a broader perspective are welcome. Examples would be papers that deal with the interfaces between APL and other hardware or software systems, or with the relations to LISP and other computer languages.

Authors should submit abstracts and papers to the Chairman of the Program Committee, Paul Penfield, Jr., Room 38-401, Massachusetts Institute of Technology, Cambridge, MA 02139. Abstracts are due by September 1, 1978, and full papers by November 15, 1978. Authors may also submit abstracts using major APL time-sharing services. Each service that is participating in this submission procedure has a workspace named 1 APL79 in the public library with details.

Our Face is Red Dept.

The poems, *Them ADP* in the Jul/Aug 1978 issue were written by William J. Wilson, not Mr. Wilton as noted in the article.

TSC's address was not included in the article on Technical Systems Consultants' word-processing software (Jul/Aug 1978, p 123). TSC is at P.O. Box 2574, West Lafayette, IN 47906.(317) 423-4565.

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We do not want programs that will require any hand-holding or support to the user (no payroll or general-ledger programs please), but we would like things like mailing lists, cataloging, text editing, statistical calculations, etc. On programs of this sort and on very large games, we would expect to market perhaps only one or two programs per tape, possibly at a higher price than $7.95.

Programs should obviously be as bug-free as possible, should be self-documenting and have user aids imbedded in them. We are aiming at a mass market of users where "if anything can go wrong, it will."

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If you don't have a PET, TRS-80, or Apple II, *Creative Computing* is still interested in your BASIC software, for possible publication in *Creative Computing Magazine, BASIC Games Volume 2,* or conversion by our in-house programming staff for one of the above-mentioned machines. (We are also looking into publication of a "super games book" of very large BASIC programs, such as a *very* sophisticated Star Trek, Kingdom, etc. Please get in touch with us if you have something! It does not have to run on a micro.) Remember, we're looking for *original* games and applications. Please send a complete listing, a sample run or two, program description, papertape, and an SASE, to Creative Computing, PO Box 789-M, Morristown, NJ 07960.

* * *

The creative mind is seldom bored.
—Gordon A. MacLeod

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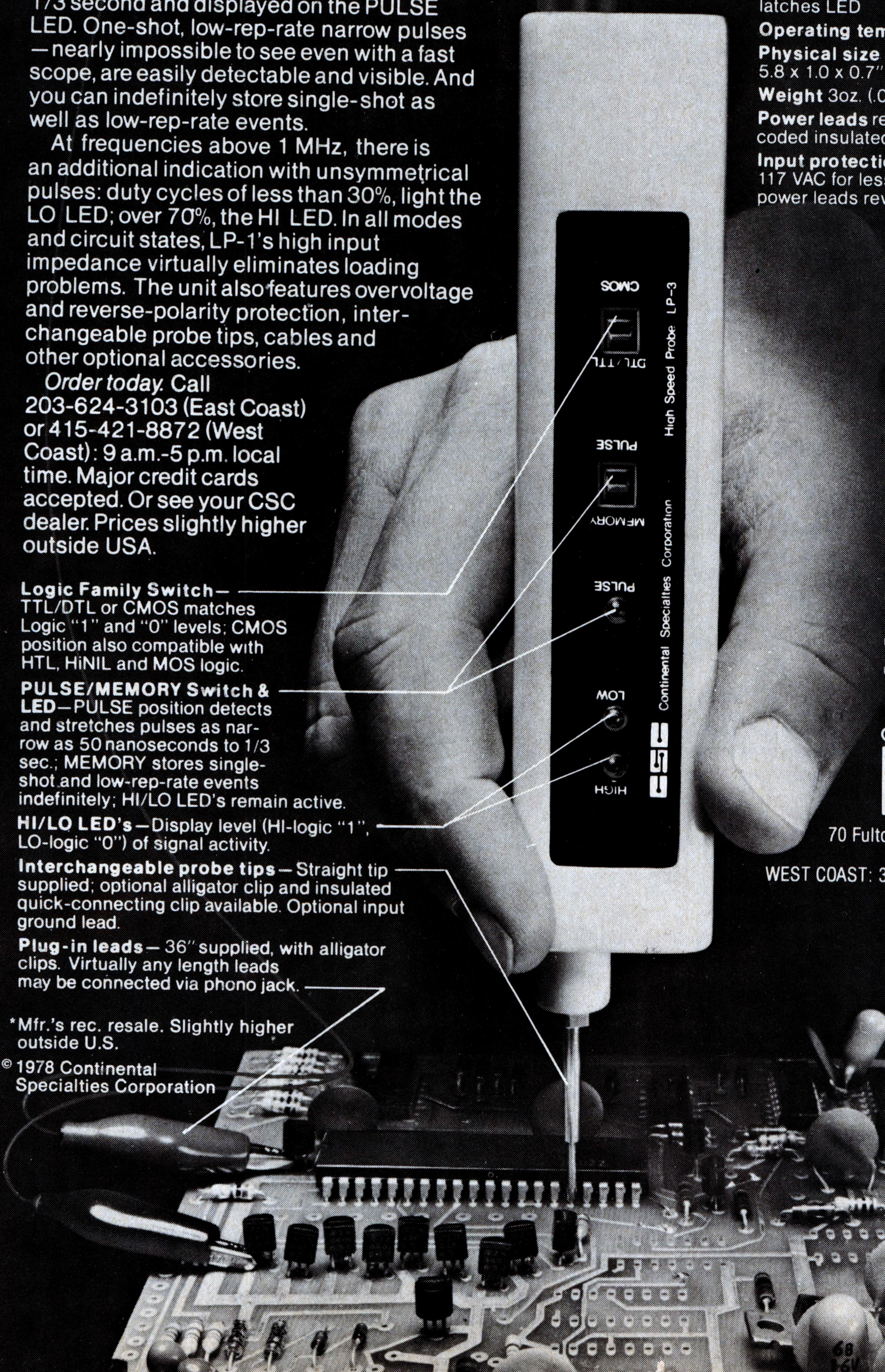
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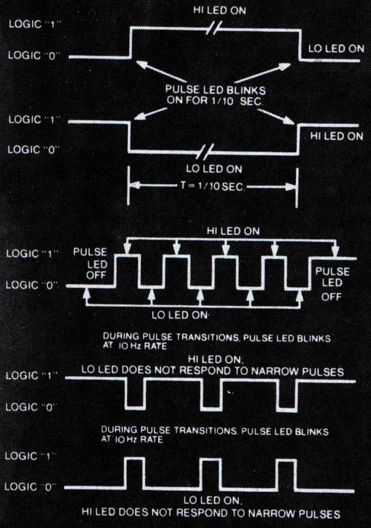
HI LED ON
LOGIC "1"
LOGIC "0"
LO LED ON
PULSE LED BLINKS ON FOR 1/10 SEC.
LOGIC "1"
LOGIC "0"
HI LED ON
LO LED ON
T = 1/10 SEC.
HI LED ON
LOGIC "1"
LOGIC "0"
PULSE LED OFF
PULSE LED OFF
LO LED ON
DURING PULSE TRANSITIONS, PULSE LED BLINKS AT 10 Hz RATE
HI LED ON;
LO LED DOES NOT RESPOND TO NARROW PULSES
LOGIC "1"
LOGIC "0"
DURING PULSE TRANSITIONS, PULSE LED BLINKS AT 10 Hz RATE
LOGIC "1"
LOGIC "0"
LO LED ON;
HI LED DOES NOT RESPOND TO NARROW PULSES

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CIRCLE 106

NEW LP-1!

Does Anyone know?

Dear Editor:

This summer I finished 6th grade, and in math I was in a special computer group. Then my father and I made a computer. He showed me mainly how to use it, also he showed me the PDP-10 and how to use that. But I have some questions to ask you about making games. Like, if I rewrote someone elses program, could I call it mine? Or does a program have to be written totally by one person? And if I converted from one kind of basic to another would it be my program? Thanks very much.

Mark Vriesenga
106 Wellington Rd.
DeWitt, NY 13214

Mark— We don't know the answers ourselves. The legal status of computer software is ambiguous. However, our opinion is that the original inventor and programmer of a game deserves credit for his work. If you rewrite the program, then it's your program, but still not your idea. Obviously converting a program from one BASIC to another does not constitute much of a change so it would be rather farfetched to call the program your own.

An Odd Event

Dear Editor:

In regard to the illustration which appeared on page 143 of the July-August 1978 issue of your fine magazine, you may assure your readers that 2^{64} is indeed an even number.

$2^{64} = 18,446,744,073,709,551,616$

Of course, the number actually printed is $2^{64}-1$, the largest integer which can be represented on a 64 bit machine using one word. I suppose the habit of subtracting 1 from powers of 2 is one of the effects of working with computers every day, not unlike going out for a byte to eat or standing on a corner waiting for an S-100 bus to arrive.

Stephen Goodney
Mathematics Department
Marymount College
Tarrytown, NY 10591

Comment on Idols

Dear Editor:

Robert Mueller's article, Idols of Computer Art, (May/June 1978) is a timely catalog of the dead ends that were bound to surface, what with graphic developments as rapid as they are in the computer field. There is hardly a professional or academic meeting of computer societies that does not have a computer art competition or exhibit. At these showcases one looks in vain for relief from those cliches Mueller has described and illustrated. Everything has been done (and done to death) already; in less than ten years.

However, a neglected point should be mentioned to lend further credence to Mueller's thesis that: "Whatever the technical route, we *are* on the verge of realizing an entirely new artistic mode."

For example, I am using a computer graphic system which can plot any one of the illustrations that Mueller selected for his article, in less time than a second. Probably in less than a minute any of those drawings can be executed not once but sixty or a hundred times; each one with some small change of one or many parameters that define the image. In only a short time I can produce tens of thousands of drawings on motion picture film—each one with its minute stepping variation. Plainly, in fact, the computer is a superb kinetic art tool for film or video. Spatiotemporal figuration is its domain; aural or visual. Much action can be generated in real-time today.

If Mueller is bored to death with lissajous figures (as well he might be) let him play any one chord, say in C#Minor, and note to himself what a bore a sustained chord (without past or future) can be. Then let him hear what any of a dozen Baroque composers were able to do with that same chord as one step of a sequence of melodic or harmonic motion. Composers of that era were just beginning to explore a vast new world of musical resources and refined instrumentation. It is such an era—once again—to compare with the Baroque flowering of music - that we are on the verge of realizing. Or so I believe. "Idols of computer art" notwithstanding.

Art in America, where the article originally appeared, carried still another comment on the article from Harold Cohen in their Jul/Aug 1972 issue.

John Whitney
17298 Avenida de la Herradura
Pacific Palisades, CA 90272

Publish or Perish

Dear Editor:

You and your readers might be interested to note a peculiar phenomenon in the "publish or perish" world of university professorial authorship. It seems that an author who publishes with Creative Computing is guaranteed something like a 100-to-1 edge in his/her subject's acceptance, popularity, coverage, etc. My article "A Comparison of Sorts" (Nov-Dec 1976, pp. 76-80), has prompted correspondence from five countries in Europe, Israel, and Australia, not to mention over a dozen US readers. It has been cited in other journals, and most important, its message, use the Shell-Metzner sort, has been enthusiastically heeded by many readers.

A note on Hart's sort coding (Jan-Feb 1978, pp. 96-101) with reference to Pat Fitzgerald's letter (Did you get that address? New Zealand, no less!) p. 10, Jul-Aug 1978: Hart's sort is a modified binary tree sort in the same family as the Quicksort, Heapsort, Shell-Metzner, and Tournament varieties. But it suffers two overwhelming disadvantages over these: (1) It is slower, and (2) it uses more memory array space ($2N + \log_2 N$ vs $N + \log_2 N$ for Quick, Heap, and Tournament, or just N for Shell-Metzner). Dennis Church, who compared the Bubble sort

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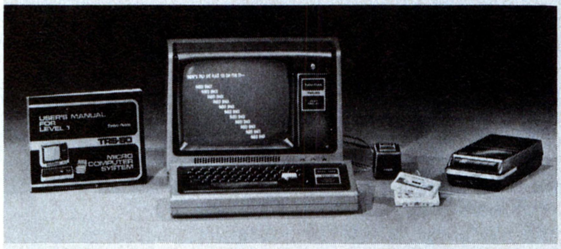

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International Society for the Preservation of Wumpii

To: Editor, Datamazing Magazine,
The Wrong Side of The River, York, APL.

Dear Dastardly Sir:

I wish to bring to your attention the advertisement that you carried in your April 1, 1978 issue of *Datamazing* promising "High-pay Careers in Wumpus Control."

Though the advertisement indicates that Wumpus Control is a glamorous job, actually it is a brutal menial task, where THOUSANDS of poor, defenseless baby Wumpii are killed each evening by brutal Hackers wielding Crooked Arrows!! The sole purpose of this murderous activity is the pleasure and enjoyment of the bit-pushing addict taking a byte of KILLER LUST FRENZY!!

After the carnage is complete, the remains of the slaughter is converted into recycled random core bits, and the Nasty Wumpus Hunters revert, like Werewolves, to ordinary harmless Programmers.

I beg of you, plead with you, and humbly request that you No Longer Advertise for the promoters of this cruel and lowly business. In fact, if you would like some of our free literature describing the delicate ecologies of imaginary dodecahedrons, and the critical role of the lovable Wumpus in maintaining the population balance of SuperBats, we will be happy to send you some with a souviner Bottomless Pit.

Thank you for your attention to this important matter. May I suggest to you our Guide and Motto:

"If you enjoy it, it must be wrong."

Boy Yrogerg, President

Cray-1 Chips

Dear Editor:

Your Datamazing parody in the Mar-Apr 1978 issue was priceless, not to mention the rest of the issue. Unfortunately unless your readers are familiar to some degree with the big-business world they might not be able to appreciate it all.

I personally would be interested in some Cray-1 chips. At the low price of $.05 I could use them for the CPU-bound task of determining whether it's dark enough outside to require turning on a light.

I spoke to our system-support expert re the 370-to-8008 conversion kit, explaining the power of the 8008. He wasn't interested because it can't handle the instructions on the yellow card, and so we'll have to suffer with our 370. He was interested in the 370 to S-100 bus adapter so we could add on more memory at reasonable prices though, when it becomes available.

Keep up the great work.

Ross Cooling
299 Forman Ave. Apt. 14
Toronto, Ontario
Canada M4S 2S6

Ed. Note: We are taking nominations now for the victim of our next April fools parody issues. Suggestions received so far include Vogue, The National Enquirer, Ms. *and* Humpty Dumpty. *—DHA*

"The mind has a great wide door, through which gossip and rumors can rush in with ease; but a new idea can hardly get in without a set of burglar tools."

Anon.

Another Reply to "IBM Hater"

Dear Editor:

Reading "IBM Hater's" letter in Jan-Feb brought back memories of "an amazing computer system" that I was acquainted with. Even before reaching the identification of the machine in the article, I knew that it was referring to the IBM 1130 computer system.

At the time it was first placed on the market the 1130 was truly an amazing system for the price. Ask any newspaper which used an 1130 for their first automated typesetting system. For many of them it was also their first system for business applications.

"Mr. IBM Hater" is comparing computer technology of ten years ago, with today's. Which is like comparing a Model A Ford with today's automobiles. He probably never saw a computer without all the modern-day bells and whistles. I don't think I would qualify as an "IBM lover", as I no longer have access to anything produced by "Big Blue" except an occasional use of a Selectric typewriter, but I think that the constant sniping at IBM by people gets to be a little ridiculous. They must have had something good and done something right to be the world-wide leader in the computer industry.

By the way, if anyone is in a position to want to junk an 1130, and would like a tax-writeoff at the same time, I'm treasurer of a non-profit homeowner's association in Arizona, and would love to have one of the old pieces of iron donated to do our various bookkeeping functions.

Jim Redpath, Treasurer
Hillcrest Bay Homeowners Assn.
Lot 84 — Hillcrest Bay
Parker, AZ 85344

Bio-Space-Time Music Synthesizer

Dear Creative Computing, Peace and Harmony.

Since the time of Pythagoras and probably before, the world has been waiting for a "tune in with Nature—biomusic" synthesizer. My bio-space-time music synthesizer (the NS: sanskrit *nadam shanti* for vibrational peace; i.e., harmony) simulates environmental energies and natural resonances with a plausible relation to good health and the mystical.

The NS helps the human mind "tune in" the cosmos—extracting energy and information by sympathetic resonance. Some natural harmonies are constant (e.g., the Schumann resonance related to the earth's electric field, telepathy, etc.); and others are affected by the earth's relative motion through space-time. Thus an astronomical clock is interfaced to computer-controlled electronic oscillators. By entering earth and space coordinates, local time and base frequency, the system computes and continuously tunes the oscillators to the correct doppler-shifted frequency. Also interfaced are frequency counters, keyboard functions, manual tuning, tonal shapers-amplifier-speakers, and optional EEG, magnetometer, radio telescope, etc., for psychotronic and SETI research (Search for Extraterrestrial Intelligence). The NS can simulate harmonic, geometric patterns of a DNA molecule or any biomolecule, organ resonance, or environmental fluctuations, space music, biofeedback music, gravitational music, NMR, or atomic music, etc. I've prepared several charts and explanations for tuning the NS.

Biomusic research is still young, but I believe my adaptable NS system should enhance Harmony and allow users to explore the beyond. The results of such research will likely include music conducive to relaxation, alertness, mental and physical efficiency.

Next month I hope to publish a pamphlet on the topic, with many charts, etc. Due to my embarrassing financial condition, I have not yet made a working prototype and am seeking help in that regard. Perhaps you could print a short blurb on computers and biomusic allowing me to advertise my pamphlet which I wish to sell for a five-dollar donation; as well as seeking intelligent feedback from your readers.

David Bihary
PO Box 1013
Fairport, OH 44077

Ed. Note: Intelligent feedback may be transmitted directly via telepathy or indirectly via U.S. Mail. —DHA

LOOKING FOR THE NEW KENTUCKY FRIED CHICKEN OR McDONALD'S? JUST OPEN YOUR EYES!

Back in the fifties, if someone had suggested you invest in a hamburger stand called McDonald's or a chicken store run by Colonel Sanders, you probably would have laughed. Most of us did. The few who didn't, and invested in KFC or Big Mac are millionaires today. They enjoy "finger lickin' good" profits and "have it all done" for them.

The whole trick to investing in your own business is to **keep your eyes open for something like a KFC or McDonald's**. A business that (1) requires a **small investment** that can be recouped quickly, (2) has an **enormous profit margin**, and (3) has great growing **consumer acceptance.**

There is such a business.

The business is computer portaits, and it's one of the hottest, most profitable new ideas around. International Entrepeneur's Magazine stated that there are locations that are currently grossing **from $2,000 to $4,000 a week**. Imagine, grossing up to $4,000 a week from a small investment that gives you **your own high volume, all cash business.** No franchise fees or royalty payments, **all the money is yours**.

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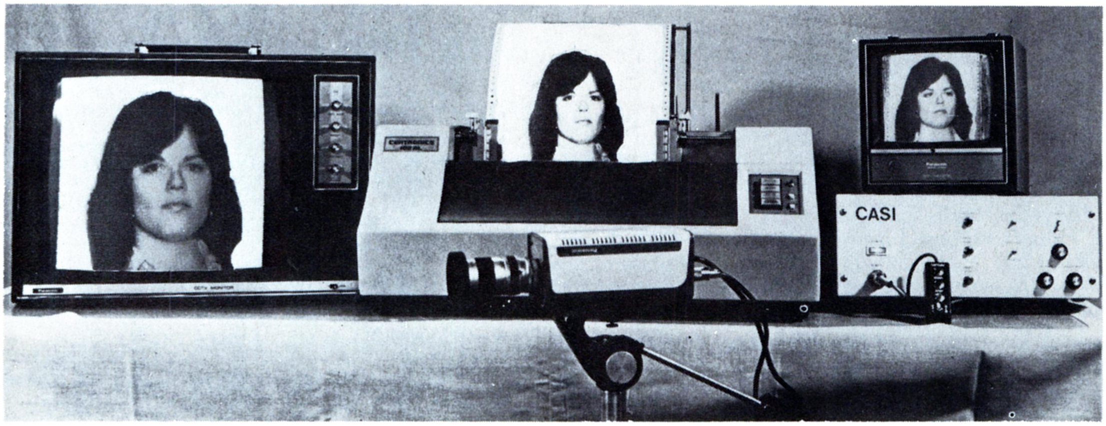

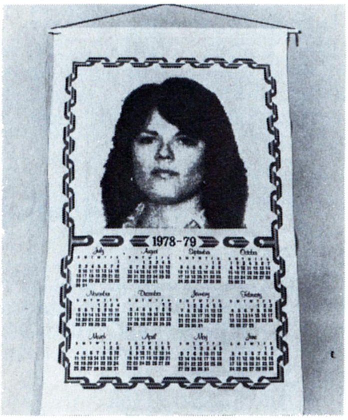

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CIRCLE 143 ON READER SERVICE CARD

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SAM76

Dear Editor:

In the recently published article on SAM76 (May-June 1978, p 30), having read the original, I cannot but help to notice a few small errors in the printing.

On page 31, the "Beginners section on procedures" is supposed to be in the right-hand column, and the top few paragraphs through the *nota bene* should be in the left column. Also the last two pages were omitted [Ed. note: they were omitted from the printout we received].

A 200-page manual on SAM76 sells for $12; a paper tape or TDL cassette of the object code will be sold for $6 in several versions; information on I/O vectors and other useful things sells for $2, from SAM76, R.R.1 Box 257, Pennington, NJ 08534, (609) 466-1130.

Karl Nicholas

To all those readers wondering about the abrupt ending to the SAM76 description, the missing last section is reproduced to the right.

Origin of Word "Debugging"?

Dear Editor:

Enclosed is an article describing the possible origin of the phrase "debugging." I thought it proper to pass along this article, seeing that much of your magazine deals with solving them. Hope you can make some use of it.

Ron Jennings
COMSAT Room 4035
940 L'Enfant Plaza
Washington, DC 20024

Ed. note: The following is excerpted from the Jan. 10, 1978, issue of the Fredericksburg, Virginia, Free Lance-Star, in an article by Elissa Vanaver titled, "40's wonder machine gave base new life," about the Harvard Mark II Relay Calculator at the Naval Surface Weapons Center in Dahlgren, Virginia.

For all its wonder, the Mark II's birth was not without snags. One night in 1946, Burke and the other technicians found something gumming up the works of the adolescent computer.

It turned out to be a wayward moth, which was extracted and memorialized in the phrase, "debugging the computer," a term since applied to working out problems in any computer program.

Niemann and Burke had the computer "bug" then, and they still have it. Burke has the moth pasted in a logbook in the Warfare Analysis Department, where he is computer operations branch head.

Palindromes

Dear Editor:

I have been intrigued by an article that had appeared in your "Best of Creative Computing, Volume I" book. The article had to do with palindromes and whether the number 1675 would ever become a palindrome after successive reversals and additions.

Just for the record, I recently ran a BASIC palindrome program for 8 hours, 20 minutes producing a number containing nearly 15,000 digits, still not palindromic. The program was run on a Burrough's B6700 computer.

I am a student of Iowa Lakes Community College in Estherville, Iowa, enrolled in their 2-year Data Processing program.

Steve Williams
102 North 17th Street Place
Estherville, IA 51334

Ed. Note: And if it had become palindromic, what then? — DHA

The following is an example of a simple character manipulation procedure:

```
{}-----------------------------------------------
{}  %dt,Q,!%ca,
{}  /%os,
{}  WHAT IS YOUR NAME?- /%dt,N,%is//%pt,N, ,
{}  /%os,MAY I CALL YOU %fe,N/?-  /%md,N/%os,
{}  WELL HELLO /%ii,%ic/,Y,!%fe,N//,!%N, ///
{}  /%Q///=
{}
------------------------------------------------
```

This procedure asks for your full name, and then asks whether or not it may call you by your first name. If you enter "Y" it will print "WELL HELLO" followed by your first name; if anything else is typed it will print "WELL HELLO and your full name, then it will fetch itself again.

```
{}-----------------------------------------------
{}  %Q/=
{}  WHAT IS YOUR NAME?- BOB EVANS
{}  MAY I CALL YOU BOB?   N
{}  WELL HELLO BOB EVANS
{}  WHAT IS YOUR NAME?- GNAT KUHN
{}  MAY I CALL YOU GNAT?   Y
{}  WELL HELLO GNAT
{}  WHAT IS YOUR NAME?- PETER EICHENBERGER
{}  MAY I CALL YOU PETER?   Y
{}  WELL HELLO PETER
{}  WHAT IS YOUR NAME?-
{}
------------------------------------------------
```

At first this procedure changes the "activator" to be the "new line" code and asks for your full name. then it will define "N" as a string input from the keyboard and partition the spaces out of "N".

Next it will display "MAY I CALL YOU" and the characters in "N" up to the first partition; if there is no partition (no spaces in "N" originally) it will be the full value of "N" which will get displayed.

Then the text divider is reset back to the beginning of "N" (it was set at the first partition by the fetch element function). Next there is an output string function with an identity function nested within it. The SAM76 processor will now compare the single character input from the keyboard as a result of evaluating the "ic" function with "Y"; if it is a "Y", then the value of the identity expression will be the first name, if not then the value will be the full value of "N" with the partitions filled back again with spaces.

The value of the identity will then be displayed preceded by "WELL HELLO". Lastly the procedure fetches "Q" again thus looping.

The following is an example of a translation procedure; it will read in a first name and display a full name. The first and full names are kept in separate texts with the items of the lists separated by commas.

```
{}---------------------------------------
{}  %dt,L,%ca, /%os
{}  TYPE FIRST NAME FOLLOWED BY A SPACE
{}  /%dt,N,%is//%pt,N%N1//%ii,%N/,,!%os,
{}  HELLO %N%N1// %N%N2////,!%os,
{}  NAME NOT KNOWN///%L///=
{}
------------------------------------------
```

The two lists of names, "N1" for first names, and "N2" for last names are defined as follows:

```
{}--------------------------------------------
{}  %dt,N1,(,BOB,GNAT,PETER,JOHN,
{}  ,DAVE,LEN,JORDAN,BARRY)/
{}  %dt,N2,(,EVANS,KUHN,EICHENBERGER,LEVINE,
{}  ,THERIAULT,BOSACK,YOUNG,KLEIN)/=
{}
---------------------------------------------
```

This procedure, with its associated two lists will first change the activator to a space, request the entry of a first name, and define "N" as the string received from the keyboard.

Then the text "N" will be partitioned using the list "N1", and if there is a match, then text "N" will become a partition of value equal to the position of the name in list "N1". A test is made to see if "N" contains only a partition (the identity test will be "null" if found) and if so the message "HELLO" followed by the first name reconstituted by fetching "N" with list "N1" to refill the partition, and a second fetch of "N" using list "N2" to replace the partition with the corresponding appropriate last name.

If there is no match to the first name then the message "NAME NOT KNOWN" is displayed before the procedure loops back by fetching "L" again.

We will leave the example that illustrates the use of this procedure to the beginner to try out.

A procedure of this sort can be used for many types of translations; an elaboration might be to have the lists grow instead of delivering a cold "NAME NOT KNOWN" message; instead an inquiry as to the required name might be made, and then both the new first name, and the matching last name are added to each of the two lists.

The editor wishes to acknowledge the derivation of this description from an early writing by Peter Eichenberger.

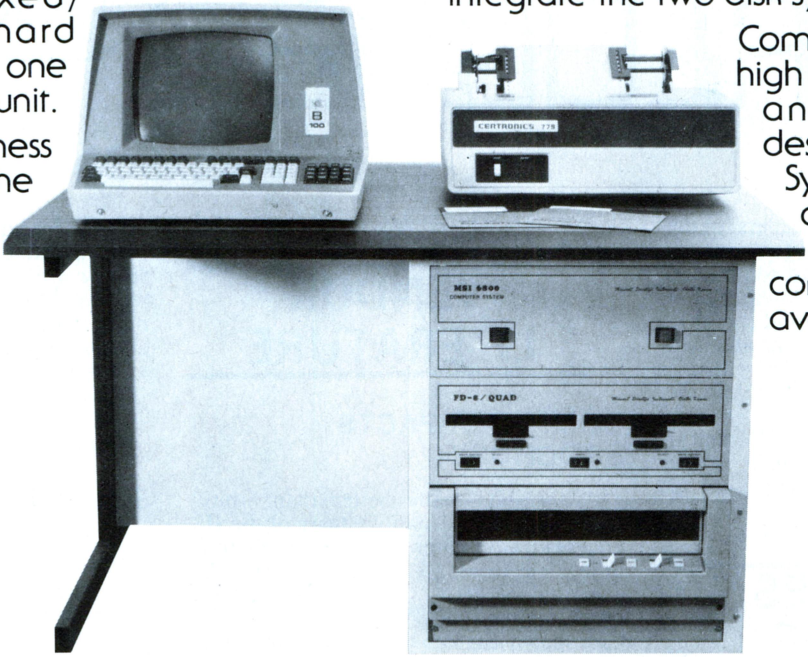
```
 -----------
||         ||
||  Nota   ||
||  Bene   ||
||_________||
```

The New MSI System 12

The MSI System 12 computer system combines the popular MSI 6800 processor...complete with 32K of memory...the MSI FD-8 QUAD floppy disk system, and the new MSI HD-8/R 10 megabyte fixed/removable hard disk system in one compact desk unit.

Ideal for business applications, the MSI System 12 gives you a large capacity hard disk for mass storage, and a floppy disk system for program loading, back-up, software updates and exchanges. The new SDOS operating system is employed to integrate the two disk systems together.

Complete with CRT, high speed printer, and convenient desk unit, the MSI System 12 is one of the most powerful microcomputer systems available today.



Arizona

Personal Computer Place
1840 W. Southern
Mesa, Arizona 85202

California

A-Vidd Electronics
2210 Bellflower Blvd.
Long Beach, California 90815

Computerland of San Mateo
42 W. 42nd Ave.
San Mateo, California 94403

Florida

Microcomputer Systems
144 S. Dale Mabry Highway
Tampa, Florida 33609

Illinois

American Microprocessors
Equipment & Supply Corporation
20 N. Milwaukie
Half Day, Illinois 60069

Computerland of Arlington Heights
50 E. Rand Road
Arlington Heights, Illinois

4C Corporation
P.O. Box 530
Mundelein, Illinois 60060

Lillipute Computer Mart, Inc.
4446 Oakton St.
Skokie, Illinois 60076

Midland Standard
P.O. Box 38
603 E. Chicago St.
Elgin, Illinois

Wysocki Electric
6563 11th St.
Rockford, Illinois 61109

Iowa

Electronic Data
1200 Locust
Des Moines, Iowa 50301

Kansas

Barney & Associates
Electronics Division
425 N. Broadway
Pittsburg, Kansas 66762

CMPTR-C
704 Taylor
Topeka, Kansas 66604

Louisiana

Freeman Electronics
1100 Ridge Ave.
West Monroe, Louisiana 71291

Gallion Data Systems
3103 Malvern
Bossier City, Louisiana 71111

Maryland

Computer Workshop
1776 E. Jefferson
Rockville, Maryland 20852

Missouri

Gallion Data Systems
201 N. 11th St.
Blue Springs, Missouri 64015

H & K Systems
15 E. 31st St.
Kansas City, Missouri 64108

Montana

Compact Computers
113 Hamilton
Butte, Montana 59701

New York

Computer Mart of New York
118 Madison Avenue
New York, New York 10006

Oklahoma

High Technology
1020 W. Wilshire Blvd.
Oklahoma City, Oklahoma 73116

Pennsylvania

The Electronics Place
7250 McKnight Rd.
Pittsburgh, Pennsylvania 15237

Gallion Data Systems
908 Knepper Drive
Mechanicsburg, Pennsylvania 17055

Texas

The Computer Shop
6812 San Pedro
San Antonio, Texas 78216

Washington

Digitek
5950 Sixth Avenue South
Suite 101
Seattle, Washington 98108

Midwest Scientific International
Chausee De Charleroi, 80
1060 Brussels, Belgium
Telex 26025

Canada

First Canadian Computer Store
44 Eglinton Avenue West
Toronto, Ontario M4R 1A1
Canada

England

Strumech Engineering
Electronics Division
Portland House
Coppice Side, Brownhills
Walsall Staffordshire
England

Computer Workshop
174 Ifield Rd.
London, England SW109AG

Germany and Austria

C.O.I. Systeme Munchen
EDV Vertriebsgesellschaft mbH
Arabellastraße 5
8000 Munchen 81
Germany

Belgium

Computer Resources
Chausee De Charleroi, 80
1060 Brussels, Belgium

Switzerland

Agence De Distribution et Vente
Case Postale 801
1211 Geneve 1
Switzerland

Australia

Sontron Instruments
Byte Shope
17arawatta St. Carnegie
Victoria, Australia 3163

The Netherlands

MRL Ectronics
Postbus 88-Delft, Foulkeslaan 100
The Netherlands

South Africa

Radiokom
Cnr. George St. & Hendrik Verwoerd Dr.
Randburg, Transvaal
South Africa

Venezuela

Tramboca (Sistema Pek 2000)
Centro Peru, PISO 2-Ofic. 23
Caracas, Venezuela

Midwest Scientific Instruments

220 W. Cedar Olathe, Kansas 66061 (913) 764-3273
TWX 910 749 6403 (MSI OLAT) TELEX 42525 (MSI A OLAT)

CIRCLE 181 ON READER SERVICE CARD

COMPLEAT COMPUTER CATALOGUE

RESOURCES
AND
TOOLS

We welcome entries from readers for the "Compleat Computer Catalogue" on any item related, even distantly, to computers. Please include the name of the item, a brief evaluative description, price, and complete source data. If it is an item you obtained over one year ago, please check with the source to make sure it is still available at the quoted price.

Send contributions to "The Compleat Computer Catalogue," *Creative Computing,* P.O. Box 789-M, Morristown, NJ 07960.

MAGAZINES, JOURNALS

THE SOFTWARE EXCHANGE

The Software Exchange is a new publication devoted to the exchange of ready-to-use software for business and the home. The Software Exchange provides classified advertising for computer software. You will be able to match your application and computer to those listed. Each program will have a description of its operation, hardware requirements, and where the provided materials can be obtained. If you have a special program you need, you can place a "Wanted" ad in The Software Exchange. In addition to advertising, each issue has editorials and reviews about micro and minicomputer software. The Software Exchange is a bi-monthly publication available at computer stores for $1.50 per issue, and by subscription for $8 per year (six issues).

The Software Exchange, Box 55056, Valencia, CA 91355.

CIRCLE 201 ON READER SERVICE CARD

Keep on Truckin'...

VENDOR LITERATURE

COMPUTER-FACTS BROCHURE

Are 16-bits really better than 8-bits? Heath Company, manufacturer of the H8 and H11 Computer Kits (and numerous other electronic kits), announces the availability of a free computer-facts brochure entitled "Why You Should Consider a Sixteen Bit Microcomputer." The new 8-page brochure has information that shouild be useful for those personal computerists who are undecided over the choice of an 8-bit or a 16-bit computer. The advantages of the 16-bit computer are discussed at length as are the limitations of the 8-bit computer. Also covered are important topics like computing power, software, service, support, reputation, quality and reliability. Included also in the brochure is an introduction to the H11 Computer, Heath's 16-bit machine that utilizes the Digital Equipment Corporation LSI-11 CPU. The H11 is available both in kit form and as a completely wired and tested unit that is fully compatible with most DEC accessories and peripherals.

Heath Company, Dept. 350-650, Benton Harbor, Michigan 49022.

CIRCLE 202 ON READER SERVICE CARD

ORGANIZATIONS

SMALL COMPUTER USERS' GROUP FORMED

Reacting to "a bewildering array of new computing alternatives," a users' group has been formed to provide a source of "unbiased, user-oriented information" on mini and micro computers for business applications. The new Association of Small Computer Users (ASCU) plans to provide members with selected publications at reduced cost, a bi-monthly newsletter and information exchange, and benchmark comparisons of competing small computer systems. Membership fees will be $25 per year for individual current or prospective users of small computers, and will include a number of periodicals and reports.

Association of Small Computer Users, 75 Manhattan Drive, Boulder, CO 80303.

CIRCLE 203 ON READER SERVICE CARD

SOL USERS' SOCIETY

The Sol Users Society is an organization for owners of Processor Technology Sol Computers and of other computers configured like the Sol. Specifically, owners of any 8080 or Z-80 microcomputer that has SOLOS, CUTER, or a functionally equivalent operating system and a Sol/CUTS cassette interface, may join. The goals of SOLUS are: (1) to facilitate communication among SOLUS members, (2) to provide a mechanism for exchange of Sol-compatible software, (3) to give feedback from SOLUS members to Processor Technology, and (4) to encourage the development and testing of Sol-compatible hardware and software produced by independent sources.

SOLUS provides the following services at this time: (1) SOLUS NEWS, a newsletter printed approximately bimonthly, keeps members informed on hardware, software, new products, bugs, local chapter meetings, and other items of interest; (2) the SOLUS Software Library collects and distributes programs in public domain and proprietary categories for nominal charges; (3) the SOLUS Music Library collects and distributes musical scores for the Processor Technology/Software Technology Music System; (4) SOLUS Local Chapters provide meetings where SOLUS members can exchange software and ideas; (5) SOLUS headquarters, being close to the Processor Technology offices, keeps a communication link with a Processor Technology Corporate officer; (6) qualified SOLUS volunteers test products for Sol compatibility and report their experiences in SOLUS NEWS. $10 a year.

Sol Users' Society, Box 23471, San Jose, CA 95153.

CIRCLE 204 ON READER SERVICE CARD

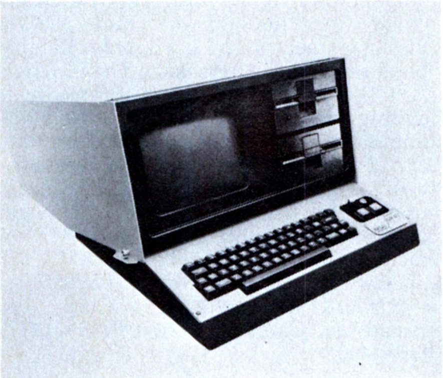
COMPUTERS

VECTOR 2 COMPUTER

Vector Graphic's VECTOR 2 desk-top computer is designed around the 158-instruction Z-80 MPU, and features a rugged low-profile cabinet with built-in keyboard. Completely assembled and tested, the standard system includes: 10-slot motherboard (S-100 compatible); Z-80 CPU board, 12K 2708 PROM/RAM board, 32K bytes of RAM memory (expandable to 64K); Vector Graphic Flashwriter video board; a 72-key keyboard containing standard typewriter keys, a numeric keypad, and several user-definable keys. Priced at under $2,000.

Yvonne Beck, Vector Graphic Inc., 790 Hampshire Rd., Westlake Village, CA 91361. (805) 497-6853.

CIRCLE 205 ON READER SERVICE CARD

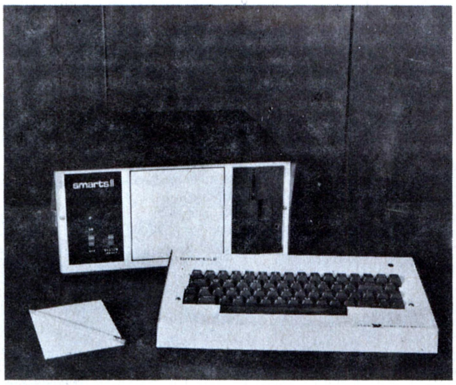


IMSAI VDP-40 COMPUTER

Imsai's VDP-40 is a fully integrated system featuring an 8085 microprocessor, 32K or 64K RAM memory, twin 5¼-inch floppies, 9-inch intelligent CRT, heavy-duty power supply programmable keyboard, motherboard, and serial and parallel I/O ports in a flip-top cabinet. Supporting software includes a disk operating system text editor, Extended and Commercial BASIC, relocatable assembler, linkage editor and ANSI Level 2 FORTRAN IV. Up to two miniature floppy drives and four floppy drives can be supported. Since the VDP-40 can support two optional disk controllers, total disk expansion capacity approaches 5 megabytes. Priced under $4,500.

Imsai Manufacturing Corp., 14860 Wicks Blvd., San Leandro, CA 94577, (415) 895-9363.

CIRCLE 206 ON READER SERVICE CARD

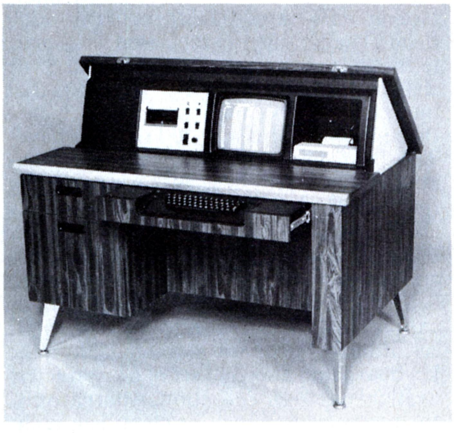


SMARTS II COMPUTER

The Smarts II microcomputer starts with 32K of RAM (read/write) memory and can expand economically to a maximum of 630K of RAM. The mini-floppy disk drive can be increased to three drives or replaced with two standard-size floppy-disk drives. Up to four more can be added to the one RS-232 interface port. Other accessories such as a CRT terminal, printer and many other such peripheral devices may be added. The Smarts II provides a full 16 lines of 64 characters per line on a standard ASCII keyboard. Color displays (7 by 9 characters) can be created on your color TV screen accompanied by action sounds from the TV speakers. A Smarts II system includes Smarts II games, income tax, bookkeeping, inventory, educational programs and more.

Fire Bird Sales Co., Box 116-03 Oak St., Woodland, IL 60974. (815) 473-4213.

CIRCLE 207 ON READER SERVICE CARD

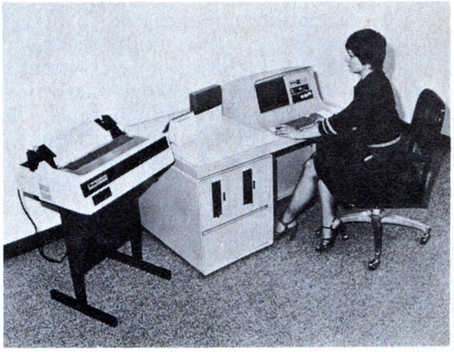


COMPUTER IN A DESK

Noval recently announced an updated version of its 760 series computer system. The user can edit, assemble and debug applications programs without the need to externally save or reload source or object code. The 760 incorporates a Z-80 microprocessor, 32K of RAM user memory plus an additional 1K scratchpad and 1K video refresh memory. The unit features a fully programmable character generator (2K) and 3K of system utility routines on PROM. Also included are a 12-inch TV monitor, digital-cassette tape recorder (software controlled), 32-column matrix printer, and a full keyboard. Three eight-bit parallel I/O ports are available for general purpose use and a programmable audio-tone generator and speaker are within the enclosure. The system design incorporates a full graphics system (256 x 224 pixels). The system is enclosed within a rosewood desk, the top of which raises automatically when a hidden trigger is depressed. The keyboard is contained within the center drawer. Optional accessories include the full operating system and development software on PROM or mag tape, BASIC on PROM or mag tape, a PROM burner card, additional I/O ports, a second independent video display card (allows program listings on one monitor and simultaneous color graphics on the other), color monitor, and RS232 interface. $3385.

Jerry Hansen, Noval, Inc., 8404 Aero Dr., San Diego, CA 92123. (714) 277-8700.

CIRCLE 208 ON READER SERVICE CARD

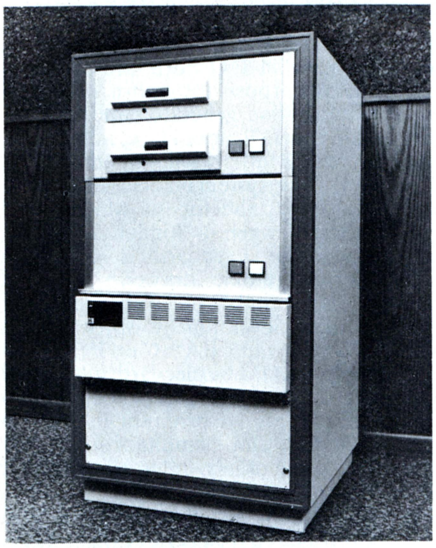


TANDY 10 BUSINESS COMPUTER SYSTEM

Tandy Computers has introduced the Tandy 10, a complete business computer system priced under $10,000 and said to have been engineered for ease of operation so existing clerical personnel can learn to operate it with minimum effort. The Tandy 10 System consists of a workstation with diskette drives integrated into a compact metal desk, and separate matrix printer that prints 60 characters/second. Faster printers are available as options. The workstation includes a video display, professional standard typewriter keyboard, 10-key calculator pad for numeric entry and 15 special-function keys for data editing. With optional peripherals, it can be used as an intelligent terminal to access larger data systems.

Each diskette can hold up to 256,000 characters, providing a total of more than ½-million characters on-line. Internal memory capacity is 50,960 characters. Screen formatting language allows user prompting for data input. The Tandy 10 comes with extended BASIC. Fortran IV and Assembly Level program languages are also available as options for the system. The Tandy 10 Business Computer System with workstation, diskette drives and matrix printer is priced at $9,950.

Tandy Computers, Department R22, P.O. Box 2932, Fort Worth, Texas 76101. Toll-free telephone (800) 433-1679.



OSI COMPUTER WITH WINCHESTER DISK

Ohio Scientific announces the C3-B, said to be the world's first fully packaged Winchester disk based microcomputer system. The C3-B is a package microcomputer system in a 42 equipment rack. The system includes, in its minimal configuration, 48K of static RAM, OSI's triple processor CPU board which has 6502A, 6800 and Z-80 microprocessors, dual floppy-disk drives for program and data mobility and a 74 million byte Winchester technology fixed disk. The Winchester disk communicates with the CPU via a dedicated high-speed memory channel which services a dual port memory. The C3-B features a 16-slot case in which only 7 slots are used in the basic machine, allowing expansion including memory up to 768K, three additional Winchester disks for 300 megabytes on line storage and 16 communications ports. Because of the disks intelligent controller, the CPU is completely available for communication such that it can always service terminal interrupts, important for high throughput operation in multi-terminal configurations. The C3-B system comes complete with OS-65U disk operating system with extended BASIC. This operating system features virtual data files and directly supports high performance file structures such as multi-key ISAM. $11,-090.

Ohio Scientific, 1333 S. Chillicothe Rd., Aurora, OH 44202. (216) 562-3101.

CIRCLE 210 ON READER SERVICE CARD

$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
WOULD YOU LIKE
TO MAKE MONEY
WITH YOUR
COMPUTER?
LET ME SHOW YOU
A POSSIBLE WAY.
FOR DETAILS
SEND 50¢ (REFUNDABLE) TO:
REAL WORLD SIMULATIONS
P.O. BOX 4107
TORRANCE, CA. 90510
$$$$$$$$$$$$$$$$$$$$$$$$$$$$$

SORCERER COMPUTER

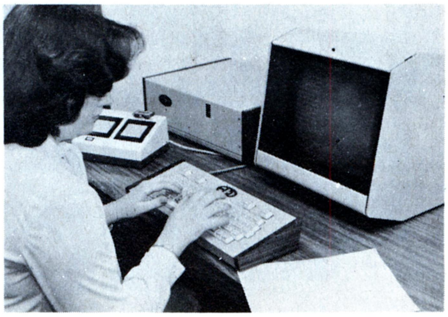
Exidy, the third largest producer of video arcade games, has entered the consumer electronics market with its new user-programmable personal computer, the self-contained Sorcerer, which needs only to be plugged into a video display and a cassette tape recorder to be a fully-functioning computer system. Exidy introduces a new concept in user-programmable personal computers with the Sorcerer's exclusive plug-in Rom Pac cartridges. The unique Rom Pacs contain high-level programming languages, operating systems or special proprietary software. Each Sorcerer comes with a Rom Pac cartridge containing Standard BASIC. Additional Rom Pacs available or now in development include a user-programmable EPROM Rom Pac, an assembler editor, a disc operating system and a word processing package. Applications programs can be loaded from one or two tape recorders through the Sorcerer's dual cassette interface at data rates of either 300 or 1200 baud. The Sorcerer can be used as a smart terminal for communications and time sharing applications. Its RS232 serial interface accepts a modem to transmit data through phone lines at 300 or 1200 baud. The Sorcerer's molded case contains ASCII keyboard with 79 keys providing full upper and lower case alphanumeric characters and graphic symbols. A 16-key numeric pad speeds information entry and inquiry.

The Sorcerer offers a total of 256 graphic expressions. In addition to its 128 ASCII set, it has 64 characters designated on the keyboard and a second set of 64 characters available for user definition. Alternatively, the two sets of 64 may be identified by the user through program control for full custom applications. Extremely fine graphic resolution of 122,880 points on the video screen is produced in a 512 x 240 format for detailed illustration. The Sorcerer displays a total of 1920 characters on the screen at one time in 30 lines by 64 characters in an 8x8 format. The Sorcerer uses the Z-80 MPU and the S-100 bus. The 12K of ROM memory includes a power-on monitor program and Standard BASIC. The 8K of RAM for user program space is expandable internally to 32K. $895 with a Standard BASIC Rom Pac cartridge.

Exidy Inc., 2599 Garcia Ave., Mountain View, CA 94043.

CIRCLE 211 ON READER SERVICE CARD

TERMINALS

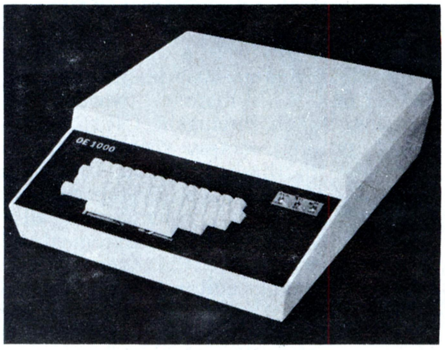


CRT TERMINAL FOR 132-COLUMN DATA

The ECD SMART ASCII is said to be the first CRT-based intelligent terminal that can display full line-printer format: up to 132 characters per line. It can display up to 40 lines on its 15″ CRT with up to 4096 characters. The standard font is the full upper- and lower-case ASCII character set, but by using the supplied font-editor program the user can design his own special characters. The keyboard is relegendable so the user can easily modify it to match a new character set. Foreign language fonts can be implemented. The interface for the SMART ASCII does not require any special protocol from the host. It communicates via a RS-232 line and looks like a simple printer/keyboard combination to the host. This allows for either direct hookup, or remote use via dial-up lines with keyboard-selectable baud rates from 110 to 9600. The SMART ASCII comes with a sophisticated text-editing program that allows complete off-line editing and supports transmitting data at a character, line, or block at a time to the host. The SMART ASCII will also execute user-written BASIC programs. The system consists of a control unit with 37K of memory, a 78-key keyboard, a 15″ CRT and two mini-cassette drives at $7900.

Richard Eckhardt, ECD Corp., 196 Broadway, Cambridge, MA 02139. (617) 661-4400.

CIRCLE 212 ON READER SERVICE CARD



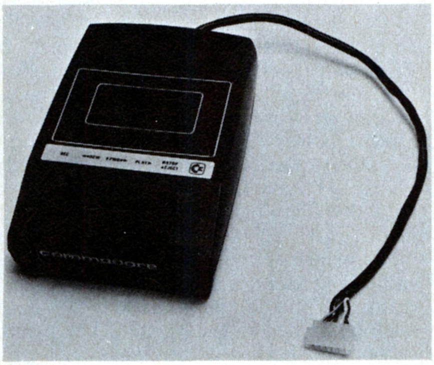
OE 1000 TERMINAL

The OE 1000 terminal is designed to interface to any microcomputer that has a 300-baud serial data output port. It operates in the full duplex mode with either 20 mA current loop or an RS232 voltage swing. The OE 1000 outputs composite video for use with a modified TV or video monitor. The screen format is 16 lines by 64 characters. It has an upper and lower case mode or TTY mode keyboard and will display 96 ASCII characters and 32 special characters. The OE 1000 has full cursor control, automatic scroll, erase to end of line, erase to end of screen, and clear screen. $275 kit, $350 assembled.

Otto Electronics, P.O. Box 3066, Princeton, NJ. 08540. (609) 448-9165.

CIRCLE 213 ON READER SERVICE CARD

PERIPHERALS



PET PERIPHERALS

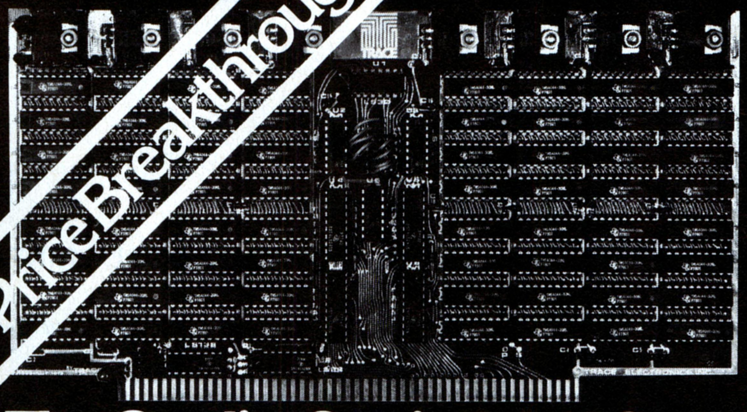
Commodore has two new peripherals for the PET personal computer. The first is the external cassette drive for expanded file keeping. It connects to the special IO Port and is available now at under $100 directly from Commodore or from PET authorized dealers. The cassette drive is capable of read/write up to 170 kilobytes. It is accessed directly from the PET through the basic command.

The second peripheral, the printer, features up to 80 characters per line on a 8½ inch wide roll or fanfolded paper. It prints at 120 cps. All Commodore upper and lower case and graphic characters can be reproduced on the printer on a 7 x 8 dot matrix. In addition, the PET can be programmed to develop a special, unique graphic character, such as a company logo, which can then be reproduced any number of times.

Commodore Business Machines, Inc., 901 California Ave., Palo Alto, CA 94304. (415) 326-4000.

CIRCLE 214 ON READER SERVICE CARD

Price Breakthrough



The Quality Static RAM from Trace Electronics...

Works and Works and Works

It works with IMSAI, Sol(Helios), Poly, Cromemco, Xitan, Vector, Horizon, Altair, North Star, Digital Systems, Alpha Micro Systems, and more.

Features:

1. Capacity: 8192 Bytes for model 800, 16384 Bytes for model 1600, 24576 Bytes for model 2400, 32768 Bytes for model 3200. (Blank boards and unpopulated boards are available also).

2. Addressing: Each 4k block separately addressable on any 4k boundary. Allows memory to be placed at the top, bottom, and anywhere in between. This feature overcomes the problem of working with software that requires memory in different places.

3. Wait states: none.

4. Speed: 450 ns. or 250 ns.

5. FULLY STATIC: no clocking, no refreshing.

6. Memory chips: High quality/reliability 4kx1, 18 pin static manufactured by Texas Instruments and second sourced by others.

7. Fully socketed: even the 8k, 16k and 24k boards contain sockets for all 32k of memory.

8. Fully assembled, tested, and burned in.

9. Lower power than equivalent capacity of low power 2102 type memory. And only one slot!

10. DMA Compatible

11. Fully Buffered: All address and data lines buffered with powerful state of the art buffers equipped with Schmitt triggers on their inputs.

12. Special Thermal Design: Each 4k of memory has a separate regulator thereby distributing the heat dissipation over 8 separate regulators. They are placed at the top of the board to allow the most efficient heat dissipation possible.

13. Megextend™: up to one megabyte can be addressed providing there is a 4 bit output port in the system. This allows up to 32 model 3200 boards per system, as long as the power requirements are met. (This feature also makes possible the use of this board in a timeshare environment)

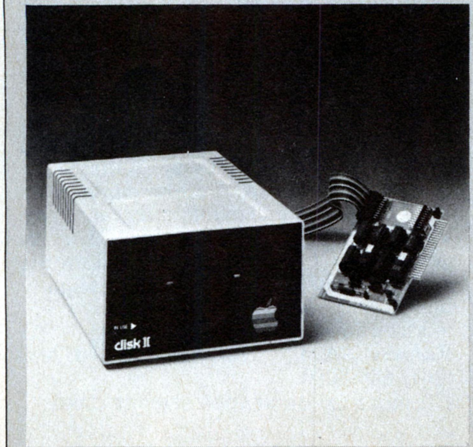
14. Power required is 1.7A at 8V for model 1600 and 3.3A at 8V for model 3200.

Our prices work too: Call, write or visit us at our sales outlet office for our new prices! You'll be surprised!

Trace Electronics Inc., 570 West DeKalb Pike,
King of Prussia, Pennsylvania 19406
(215)265-9220

TRACE
"The reliable ones"

CIRCLE 121 ON READER SERVICE CARD



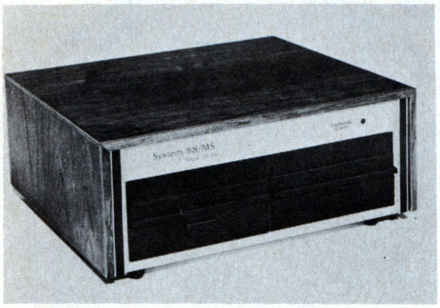
APPLE DISK

Apple Computer, Inc. has announced Disk II, the newest intelligent peripheral for its Apple II personal computer. The new device is "the easiest to use, lowest priced, and the fastest minifloppy disk drive yet offered by any personal computer manufacturer." Disk II provides rapid access to programs and data which makes home applications like address files, social appointment calendars, and recipe files faster and more useful. Disk II's advanced Disk Operating System (DOS) software, provides dynamic disk space allocation, so a system user need not be concerned with the size or physical location of a file on the disk. The DOS performs this housekeeping function; the user simply indicates the name of the file being stored or retrieved. True random or sequential data access can be enjoyed without regard to the physical location of data on the disk. Moreover the DOS provides compatibility with existing languages through the use of standard BASIC commands.

The Disk II subsystem consists of an intelligent interface card and either one or two mini-floppy drives. The computer will handle up to seven controller cards and fourteen drives for instant access to more than 1.6 milion bytes of data. The combination of a bootstrap loader in ROM (read only memory) and an operating system in RAM provides powerful disk-handling capability. $495, including controller card and Disk II drive.

Apple Computer Inc., 10260 Bandley Dr., Cupertino, CA 95014. (408) 996-1010.

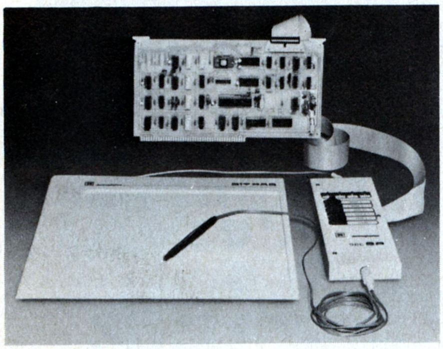
CIRCLE 215 ON READER SERVICE CARD



POLYMORPHIC MASS STORAGE

PolyMorphic Systems has greatly increased the storage capabilities of its System 88 microcomputers through the introduction of a new option, the 88/MS, which consists of two drives for 8-inch magnetic storage disks in a walnut cabinet with brushed aluminum front panel that matches other products in PolyMorphic's System 88 line. The 88/MS makes possible mass storage through the use of disks that are not only larger than mini-floppy disks but will store twice as much information per square inch and store it on both sides. One disk can hold 1.2 Mb, more than 500 pages of text. A System 88 microcomputer with one or two 88/MS units will handle all the files and processing needs of most small businesses and professional offices. Present owners of any System 88 microcomputer can add the 88/MS mass storage unit with no changes in their equipment's operating system. Ready-to-use packages for doing such tasks as accounts receivable are available.

PolyMorphic Systems, Inc., 460 Ward Drive, Santa Barbara, CA. 93111.



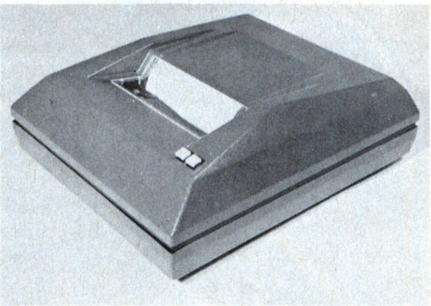
NEW BIT PAD

Summagraphics announces a new version of its popular low-cost Bit Pad, the digitizer for small computer systems. The new Bit Pad configuration is Intel Multibus compatible. The Bit Pad can now be plugged into the Multibus along with Single Board Computers (SBC), memory and I/O boards, peripherals and controllers.

All electronics are located on one SBC card. Operational control and status indication is provided from a small, hand-held console. The system also includes an 11" x 11" Bit Pad tablet and a date-input stylus. $625.

Summagraphics Corp., 35 Brentwood Avenue, Fairfield, CT 06430, (203) 384-1344.

CIRCLE 217 ON READER SERVICE CARD



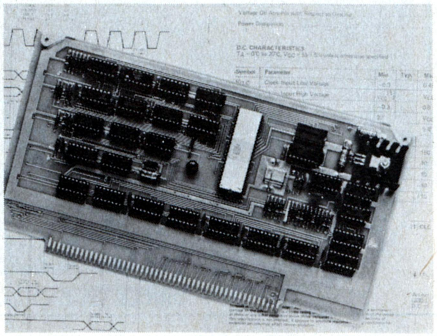
BI-DIRECTIONAL PRINTER

The MarComm SP-100 is a 5x7 dot-matrix bi-directional impact printer. Print rate is 120 cps, throughput is 75 lines/minute. Line capacity is 80 characters at 10 characters per inch. The SP-100 uses standard 8½-inch roll paper and standard ribbon cartridge. Baud rate and parity are selectable. Paper advance is motor drive, with both pressure roller and pin feed. Line feed is 150 milliseconds; 400 lines/minute slew rate. The SP-100 is designed for high mechanical reliability, utilizing the smallest number of moving parts of any comparable printer sold today. The printer also features the latest electronic technology, including micro-processor control and opto-isolators for BOL, EOL and character position sensing, with RS232C input. The SP-100 line printer combines speed, quality, durability and economy. $1,250.

MarComm Inc., 124 10 St., Ramona, CA 92065. (714) 789-3833.

CIRCLE 218 ON READER SERVICE CARD

MISC. HARDWARE

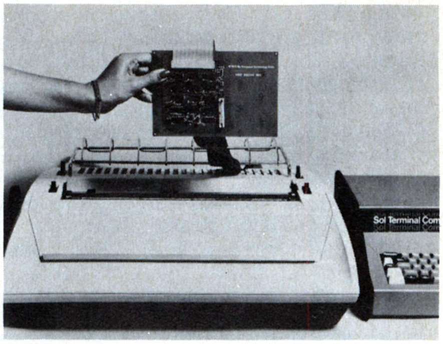


Z-80 CPU BOARD FROM VECTOR GRAPHIC

A Z-80 CPU board, offered assembled or in kit form, is now available from Vector Graphic, Inc. The new board offers fully blocked design with on-board wait-state select, is jumper-selectable for operation at 2 mhz or 4 mhz, and will operate standard 8080 software without modification. All Z-80 lines are fully buffered. Available from Vector Graphic computer store dealers for $175 kit, $215 assembled.

Vector Graphic Inc., 790 Hampshire Road, Westlake Village, CA 91361. (805) 497-6853.

CIRCLE 219 ON READER SERVICE CARD

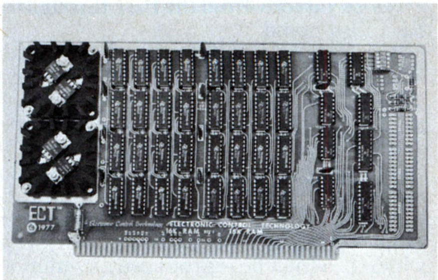


PRINTER INTERFACES

Two new printer interfaces for the Sol Computer have been announced by Processor Technology Corporation. Both increase the hard-copy capability of the Sol Computer. Sol Hytype I mounts inside any Diablo Series 1200 Printer, connecting it directly to the back of the Sol. Similarly, the Sol Hytype II Printer Interface works with the Diablo Series 1300 Printer. The installation package includes the assembled, printed-circuit board, software, all cables and mounting hardware. No modification to the Sol is necessary. No holes need be drilled in the printer. The printer can be restored to its original condition if required. Hytype driver software is included on CUTS cassette along with a source listing. The user may modify the driver software to suit a particular application. Suggested retail price for both the Hytype I and Hytype II is $150.

Processor Technology Corp., 7100 Johnson Industrial Drive, Pleasanton, CA 94566. (415) 829-2600.

CIRCLE 220 ON READER SERVICE CARD

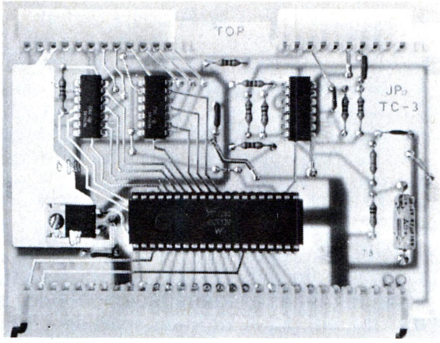


16K RAM STATIC MEMORY

Electronic Control Technology's 16K RAM memory board is a fully static 16K S-100 bus memory board which utilizes a 4K fully static memory IC (TMS-4044) like the 21L02 except that it has four times the capacity per IC package and less power per bit. Being fully static eliminates the incompatability with DMA devices or other devices which sometimes occurs with dynamic or clocked static memory. All signals to MOS devices are buffered by low-power TTL to prevent damage by static electricity and to minimize capacitive loading on the bus. Low-profile IC sockets are provided for all ICs. 2MHz operation is standard and 4MHz is optional at a slightly higher price. $350 kit.

Electronic Control Technology, 763 Ramsey Ave., Hillside, NJ 07205. (201) 686-8080.

CIRCLE 221 ON READER SERVICE CARD



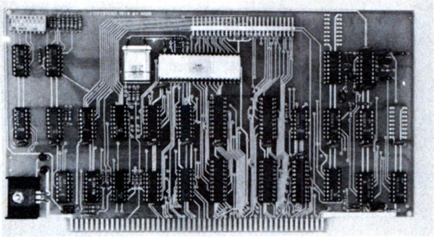
CASSETTE INTERFACE

The TC-3 cassette interface board announced by JPC Products Company provides high-performance program storage for SWTPC computer systems. The interface board plugs into one I/O slot of the SWTPC motherboard, eliminating the inconvenience of a separate cabinet. Connection is made to a standard cassette recorder through two audio cables. The interface operates at 4800 baud and loads a 4K file in 8 seconds. Data is recorded in a modified FM format similar to disk systems.

Applications include use as the primary mass-storage device for SWTPC computers that are presently using much slower papertape or "Kansas City" cassette recording, and as high-speed back-up storage on disk based systems. The TC-3 also provides a fully buffered 8-bit output port capable of directly sinking 40 ma at 30 volts. The port has full handshake and interrupt capability for use as a parallel data port, or as discrete output lines to control the cassette recorder. $49.95 kit.

JPC Products Company, P.O. Box 5615, Albuquerque, NM 87185.

CIRCLE 222 ON READER SERVICE CARD

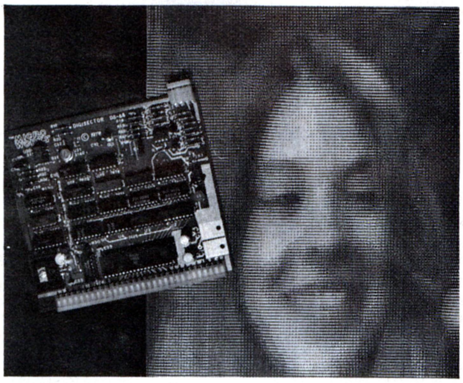


S-100 ADAPTER FOR PET

HUH Electronics has announced the S-100 MPA, an S-100 bus adapter for the Commodore PET computer. This S-100 sized card plugs into the user's mainframe and a cable connects to the PET, allowing the use of the wide range of peripheral and memory cards available for the S-100 Bus. The S-100 MPA (Memory and Peripherals Adapter) is said to be unique in that it emulates the true S-100 Bus including full DMA, true PSYNC generation, I/O address mirroring, read wait states and much more. An important feature of this versatile board is that it can also act as a stand-alone 6502 CPU board for the S-100 Bus. It is the "only 6502-based processor board to be truly S-100 Bus compatible. A simple option kit is all that is required." Kit, $199.95; assembled, $279.95.

HUH Electronics, 1429 Maple St., San Mateo, CA 94402. (415) 573-7359.

CIRCLE 223 ON READER SERVICE CARD



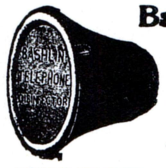
DIGITAL VIDEO SYSTEM

The Micro Works has introduced a new device that allows a 6800 computer system to see! The Digisector (DS-68) functions in conjunction with an inexpensive television camera to present the computer with a high-resolution digitized picture of the scene in view of the camera lens. The Digisector requires one I/O slot in the SWTPC 6800 computer (or equivalent) and accepts either interlaced (NTSC) or non-interlaced (industrial) sync pulses from the video source. It features 256-by-256 picture-element resolution, with up to 64 levels of grey scale. Data-conversion times vary with resolution requirements but can be as low as three microseconds per picture element. The computer portrait shown in the picture was taken by a Micro Works DS-68 and printed on the Malibu Design Group's Model 160 printer.

Operation is simple; the computer sends the Digisector two 8 bit addresses (X and Y coordinates), and the Digisector returns the digitized brightness of the image at the specified location. For set-up and monitoring purposes the Digisector also produces an output, comprised of the camera's video signal plus a superimposed intensified cursor, showing exactly where the Digisector is looking. Applications include precision security systems, moving-target indicators, computer portraiture, fast-to-slow-scan conversion for ham radio operators, and salvation for a DROID in dire need of a wall socket. With clever software, the Digisector can read paper tape, punched cards, strip charts, bar codes, and musical scores. Software for computer portraiture and slow-scan television is included. $169.95.

The Micro Works, Box 1110, Del Mar, CA 92014. (714)756-2687.

CIRCLE 224 ON READER SERVICE CARD

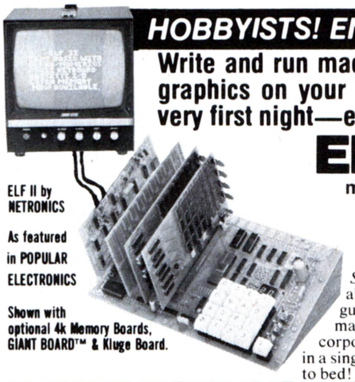


Bashlin Telephone Disinfector

One of the greatest sanitary inventions of the age. Endorsed by forty Health Boards throughout the United States.
Dust, Moisture and Germ Proof
Price 50 cents. Postpaid.

Tatem Manufacturing Company
Buffalo, N. Y., U. S. A.

AGENTS WANTED.



HOBBYISTS! ENGINEERS! TECHNICIANS! STUDENTS!

Write and run machine language programs at home, display video graphics on your TV set and design microprocessor circuits—the very first night—even if you've never used a computer before!

ELF II featuring RCA COSMAC microprocessor/mini-COMPUTER $99.95

ELF II by NETRONICS

As featured in POPULAR ELECTRONICS

Shown with optional 4k Memory Boards, GIANT BOARD™ & Kluge Board.

Stop reading about computers and get your hands on one! With a $99.95 ELF II and our *Short Course* by Tom Pittman, you master computers in no time at all! ELF II demonstrates all 91 commands an RCA 1802 can execute and the *Short Course* quickly teaches you to use each of the 1802's capabilities. ELF II also displays graphics on any TV set, including an exciting new target/missile gun game! Add-ons are among the most advanced available anywhere. You get massive computing potential. No wonder IEEE chapters, universities and major corporations all use ELF II to train engineers and students! Kit is easily assembled in a single evening and you may still have time to run your first programs before going to bed!

SEND TODAY!

NOW AVAILABLE FOR ELF II—

☐ Tom Pittman's ***Short Course On Microprocessor & Computer Programming*** teaches you just about everything there is to know about ELF II or any RCA 1802 computer. Written in non-technical language, it's a learning breakthrough for engineers and laymen alike. **$5.00** postpaid!

☐ Deluxe metal **cabinet** with plexiglas dust cover for ELF II, **$29.95** plus $2.50 p&h.

☐ ELF II connects to the video input of your TV set. If you prefer to use your antenna terminals, order **RF Modulator, $8.95** postpaid.

☐ **GIANT BOARD™** kit with cassette I/O, RS 232-C/TTY I/O, 8-bit P I/O, decoders for 14 separate I/O instructions and a system monitor/editor, **$39.95** plus $2 p&h.

☐ **Kluge** (Prototype) **Board** accepts up to 36 IC's. **$17.00** plus $1 p&h.

☐ **4k Static RAM** kit. Addressable to any 4k page to 64k. **$89.95** plus $3 p&h.

☐ Gold plated **86-pin connectors** (one required for each plug-in board). **$5.70** postpaid.

☐ Professional **ASCII Keyboard** kit with 128 ASCII upper/lower case set, 96 printable characters, onboard regulator, parity, logic selection and choice of 4 handshaking signals to mate with almost any computer. **$64.95** plus $2 p&h.

☐ Deluxe metal **cabinet** for ASCII Keyboard, **$19.95** plus $2.50 p&h.

☐ ELF II **Tiny BASIC** on cassette tape. Commands include SAVE, LOAD, ±, ×, ÷, ( ), 26 variables A-Z, LET, IF/THEN, INPUT, PRINT, GO TO, GO SUB, RETURN, END, REM, CLEAR, LIST, RUN, PLOT, PEEK, POKE. Comes fully documented and includes alphanumeric generator required to display alphanumeric characters directly on your TV screen without additional hardware. Also plays tick-tack-toe plus a drawing game that uses ELF II's hex heyboard as a joystick. 4k memory required. **$14.95** postpaid.

☐ Tom Pittman's **Short Course on Tiny BASIC** for ELF II, **$5** postpaid.

☐ **Expansion Power Supply** (required when adding 4k RAM). **$34.95** plus $2 p&h.

☐ **ELF-BUG™ Deluxe System Monitor** on cassette tape. Allows displaying the contents of all registers on your TV at any point in your program. Also displays 24 bytes of memory with full addresses, blinking cursor and auto scrolling. A must for the serious programmer! **$14.95** postpaid.

Coming Soon: A-D, D-A Converter, Light Pen, Controller Board, Color Graphics & Music System . . . *and more!*

Call or write for wired prices!

Netronics R&D Ltd., Dept. CC9
333 Litchfield Road,
New Milford, CT 06776
Phone (203) 354-9375

Yes! I want to run programs at home and have enclosed: ☐ **$99.95** plus $3 postage & handling for **RCA COSMAC ELF II kit,** ☐ $4.95 for power supply (required), ☐ $5 for RCA 1802 User's Manual, ☐ $5 for *Short Course on Microprocessor & Computer Programming*.

☐ **I want mine wired and tested with power supply, RCA 1802 User's Manual and *Short Course* included for just $149.95 plus $3 p&h!**

☐ I am also enclosing payment (including postage & handling) for the items checked at the left.

Total Enclosed (Conn. res. add tax) $________ ☐ Check here if you are enclosing Money Order or Cashier's Check to expedite shipment.

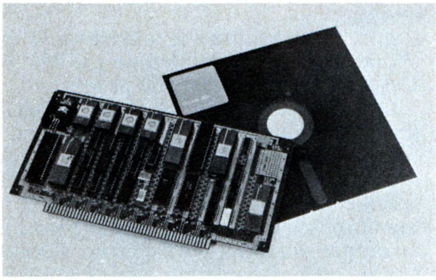
USE YOUR ☐ VISA ☐ Master Charge
(Interbank # ___ ___ ___ ___)
Account # ________
Signature________ Exp. Date______

PHONE ORDERS ACCEPTED (203) 354-9375

Print Name ________
Address ________
City ________
State ______ Zip ______

DEALER INQUIRIES INVITED

CIRCLE 160 ON READER SERVICE CARD

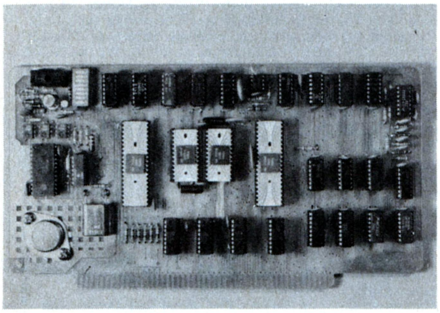


PERSCI DOUBLE-DENSITY DISKETTE CONTROLLER

PerSci's new Z-80-based double-density diskette drive controller is said to be among the first designed for full IBM diskette 2D, IBM 3740 and S-100 bus compatibility. This stand-alone intelligent controller, the PerSci 1170, can manage either single- or double-density recording on as many as 32 diskette sides for a total system formatted data capacity of 16 megabytes. The 1170 is, in effect, a compact computer for use in diskette subsystem management and microcomputer applications. It uses microprocessor intelligence to communicate by file name and assume housekeeping functions usually performed by the CPU, thus minimizing the software burden. File management functions include initialization; allocation and deallocation of diskette space; error detection and retry; creating, deleting, renaming, copying of files; and even diagnostic testing. Designed to operate PerSci's recently introduced 299 drive, "the industry's first double density dual headed diskette drive," the 1170 will support up to eight of the 299 four-headed units at one time.

PerSci, Inc., 12210 Nebraska Ave., West Los Angeles, CA 90025. (213)820-3764.

CIRCLE 225 ON READER SERVICE CARD

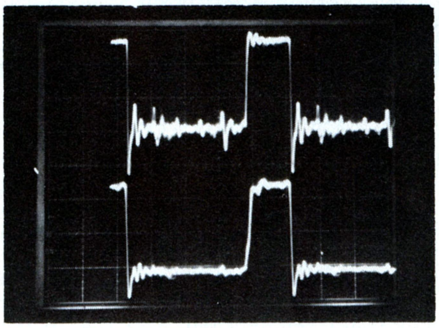


6800 CPU CARD FOR S-100 BUS

DATATRONICS, a division of Great Plains Communications & Electronics, Inc., has announced a new 6800-CPU Microprocessor card for the S-100 Bus, "bringing all the advantages of the 6800's sophisticated bus-oriented architecture and its comprehensive, PDP-11 like instruction set to the S-100 user. The extensive software support for the 6800 is available at last to the S-100 Bus user." This microprocessor card provides fully turn-key operation and maximum system compatibility as well as an RS-232/20ma interface (baud rate selectable with a DIP switch), papertape reader control, Mikbug ROM Operating System (other operating systems also available), power on reset, onboard dynamic memory refresh, slow memory interfacing (up to 5 usec access time), and tri-state data, address, and control lines all on one card. $179.00 kit, $269.00 assembled.

Datatronics, 208 E. Olive, Lamar, CO 81052. (303) 336-7956.

CIRCLE 226 ON READER SERVICE CARD



GLITCH GRABBER

Extensys Corp. has announced a board interconnection device that significantly reduces noise, glitches and jitter on the S-100 microcomputer bus. Called the Extensys "Glitch Grabber," the printed circuit edge-connective device maintains clean signals on the notoriously noisy S-100 bus, safeguarding the low tolerance voltage differential of bus signals that are asserted "high." The oscilloscope signals show the before (top) and after reduction in noise made possible by the Glitch Grabber. The Extensys device provides glitch-free signals (no spikes interference, cross-talk) by bringing some well-documented analog techniques from transmission-line analysis to the digital world of S-100 computers. $79.50.

Ed Hartnett at Extensys, 380 Bernardo Ave., Mountain View, CA 94040. (415) 969-6100.

CIRCLE 227 ON READER SERVICE CARD

HELMET OIL LUBRICATES ANYTHING.
IF YOU HAVE A HOT BOX TRY IT. C.H.BESLY & CO. CHICAGO·ILL·U.S.A.
15 to 21 Clinton Street.

SOFTWARE

EDUCATIONAL SOFTWARE

A variety of educational programs on cassette, for the Radio Shack TRS-80 Level I and Level II, Commodore PET, and Apple II, is available from Program Design, Inc. *Step-by-Step* is a three-cassette course that teaches how to program a microcomputer in BASIC, for $29.95. *Preschool IQ Builder*, at $9.50, is one of a series of "IQ Builder" tapes for tots (another series is for high school, college and adult ages) that develop skills.

Program Design, Inc., 11 Idar Ct., Greenwich, CT 06830.

CIRCLE 228 ON READER SERVICE CARD

BASIC FOR FAIRCHILD F8

Micro Business Systems has a full BASIC interpreter for use with Fairchild's F8 microprocessor. Called MBS-BASIC, the new product features 9-digit precision and floating point arithmetic. Including all standard arithmetic operations and relations, MBS-BASIC is competitive in speed and efficiency with the 8080 and Z-80 BASIC interpreters, and has 9-digit floating-point precision. MBS-BASIC version 1.0 has a license fee of $179.95, is distributed on ASR33-compatible paper tape and is provided with documentation.

Micro Business Systems, Box 8255, JFK Station, Boston, MA 02114. (617) 682-1854.

CIRCLE 229 ON READER SERVICE CARD

PET WORD PROCESSOR

Connecticut Microcomputer has a word processor program for the Commodore PET. This program permits composing and printing letters, flyers, advertisements, manuscripts, articles, etc., using the Commodore PET and an RS-232 printer. Script directives include line length, left margin, centering, and skip. Edit commands allow the user to insert lines, delete lines, move lines, change strings, save onto cassette, load from cassette, move up, move down, print and type. The Word Processor Program addresses an RS-232 printer through a CmC printer adapter. $29.50.

Connecticut Microcomputer, 150 Pocono Road, Brookfield, CT 06804.

CIRCLE 230 ON READER SERVICE CARD

STAR WARS SIMULATION

The Star Wars demonstration program used by Objective Design as a display of the graphics capabilities of the Programmable Character Generator is now available for distribution. The game, an adaptation of the end of the movie battle against the Death Star, is a true, real-time simulation. Under player control, ships move in three dimensions to create a realistic simulation of actual space flight. Objects increase in size as the ships approach and diminish as they pass. Weapons, deflector screens, and a directional control joystick are implemented in each ship. True to the original storyline, ships of the Rebel forces must pass through Imperial defenses and Tie-fighters to enter a channel on the Death Star. If they can avoid a crash into the channel wall and avoid the gunsights of pursuing ships, they have a chance to destroy the Death Star. The game requires the high-density graphics display provided only by the Programmable Character Generator. Written in 14K of 8080 assembly language, the program code is being offered on Tarbell and CUTS tape. Game rules and instructions for assembling the required ship-control boxes are included in the price of $7.50.

Objective Design, Inc., P.O. Box 20325, Tallahassee, FL 32304. (904) 224-5545.

CIRCLE 216 ON READER SERVICE CARD

North Star ★ Computers
HORIZON

HORIZON
THE COMPLETE COMPUTER

Look To The North Star HORIZON Computer.

HORIZON™— a complete, high-performance microprocessor system with integrated floppy disk memory. HORIZON is attractive, professionally engineered, and ideal for business, educational and personal applications.

To begin programming in extended BASIC, merely add a CRT or hard-copy terminal. HORIZON-1 includes a Z80A processor, 16K RAM, minifloppy™ disk and 12-slot S-100 motherboard with serial terminal interface — all standard equipment.

WHAT ABOUT PERFORMANCE?

The Z80A processor operates at 4MHZ — double the power of the 8080. And our 16K RAM board lets the Z80A *execute at full speed.* HORIZON can load or save a 10K byte disk program in less than 2 seconds. Each diskette can store 90K bytes.

AND SOFTWARE, TOO

HORIZON includes the North Star Disk Operating System and full extended BASIC on diskette ready at power-on. Our BASIC, now in widespread use, has everything desired in a BASIC, including sequential and random disk files, formatted output, a powerful line editor, strings, machine language CALL and more.

EXPAND YOUR HORIZON

Also available — Hardware floating point board (FPB); additional 16K memory boards with parity option. Add a second disk drive and you have HORIZON-2. Economical serial and parallel I/O ports may be installed on the motherboard. Many widely available S-100 bus peripheral boards can be added to HORIZON.

QUALITY AT THE RIGHT PRICE

HORIZON processor board, RAM, FPB and MICRO DISK SYSTEM can be bought separately for either Z80 or 8080 S-100 bus systems.

HORIZON-1 $1599 kit; $1899 assembled.
HORIZON-2 $1999 kit; $2349 assembled.

16K RAM — $399 kit; $459 assembled; Parity option $39 kit; $59 assembled. FPB $259 kit; $359 assembled. Z80 board $199 kit; $259 assembled. Prices subject to change. HORIZON offered in choice of wood or blue metal cover at no extra charge.

Write for free color catalogue or visit your local computer store.

NORTH STAR ★ COMPUTERS
2547 Ninth Street • Berkeley, California 94710 • [415] 549-0858.

CIRCLE 165 ON READER SERVICE CARD

CASSETTE MAGAZINE FOR PET COMPUTERS

CURSOR is a monthly cassette magazine of programs written just for the Commodore PET computer. Each issue contains a featured game, as well as a variety of other professionally written and tested programs for the 8K PET. CURSOR also provides practical programs for business, for statistical data analysis and for use in the home. There are educational programs children will enjoy, and some computer lore for dedicated "hackers." This magazine is distributed each month by First Class mail on a C-30 cassette, at $24 for 12 issues.

CURSOR, Box 550, Goleta, CA 93017.

CIRCLE 231 ON READER SERVICE CARD

Radio Shack
TRS-80
VIDEO DISPLAY

TRS-80 MICROCHESS

Micro-Ware Limited's MICROCHESS 1.5 for the Radio Shack TRS-80 microcomputer is a 4K Z-80 machine-language program utilizing every available byte of user RAM in the TRS-80. Standard algebraic notation is used to describe the moves to the computer. Every move is verified for legality to prevent user error. A simple command allows temporary numbering of the squares to assist in move entry. The chess board is displayed using the graphics mode available on the TRS-80. The moving pieces even flash before they move to simulate the gradual narrowing of attention on the moving piece as found in human chess play. The program has three separate levels of play. $19.95.

Micro-Ware Ltd., 27 Firstbrooke Rd., Toronto, Ontario, Canada. M4E 2L2. (416) 424-1413.

CIRCLE 232 ON READER SERVICE CARD

650X ASSEMBLER/TEXT EDITOR

The comprehensive resident assembler/text editor announced by ARESCO is a complete system for entering, storing, editing, and assembling programs for 650X-based processing systems. Although designed primarily for use with the KIM system, the editor/assembler can be used on any 650X system such as TIM, Apple, OSI, Baby!, etc. and is supplied with a complete source listing. The text editor, for creating, editing, and saving line-numbered text files stored in RAM, supports such functions as entering new text, deleting text, finding a designated string in text, resequencing line numbers, listing a specified block of text, loading text from paper tape or audio cassette, returning to the monitor, dumping the text file to paper tape or audio cassette, clearing the text area, and transferring control to the assembler. The editor features line-number orientation for ease of use. Users can extend the editor to fit their needs since any command preceded with an "X" is passed to a user-specifiable routine. Text files are completely relocatable in memory, and multiple text files may be in memory simultaneously. The length of text files is limited only by available memory. The resident assembler is a single-pass assembler which accepts the entire 650X instruction set, using the standard MOS Technology notation. Source code may be paper tape or memory resident, and object code is always written to memory. The complete system occupies 6K of memory (from E000 to F7FF) and object code is available on KIM cassette or paper tape (KIM/TIM format) for $70.

ARESCO, 450 Forest Ave./Q-203, Norristown, PA 19401.

CIRCLE 233 ON READER SERVICE CARD

UNIVERSAL DATABASE AND EDITOR FOR APPLE II

This Universal Database is said to be unique in that the fields used are "predetermined neither in number or length of each field although there is a maximum of how many and how long each may be. It's universal because you define the number of fields, their lengths, and title of each field."

The APPL-E-DITOR is used mainly in developing letters, documentation, and other forms that will be changed again and again. The functions permit adding lines, changing text, deleting, inserting, listing, modifying a line at a time, renumbering, etc.

Both programs are written for an Apple II with 20K+ memory; the database cassette is $60, the editor cassette $50.

Darrell's Appleware House, 17638 157th Ave., S.E. Renton, WA 98055.

CIRCLE 234 ON READER SERVICE CARD

8080 TEXT-PROCESSING SYSTEM

The Technical Systems Consultants 8080 text processing system allows the use of over 50 commands for special text-formatting applications. the commands included will support multiple spacing, left-margin control, indenting, the ability to save continguous text, paging, left-hand justification, right-hand-only justification, left and right justification, centering, no-fill modes, page numbering, the printing of left, right, or centered titles, and line length control. Also included are capabilities for macro definition to define and build special formatting commands, number registers which can be used like variables in a program, conditional command execution, setable macro execution points (to execute a macro at a predefined line number), the ability to prompt a terminal for text during the formatting process, and a feature which allows sending informative strings to the terminal. The system also outputs numbers in either Arabic, capital Roman numerals, or small Roman numerals. Tab columns may be defined as well as the tab character and tab-fill character. Environment switching is permitted for easy parameter changing and a loop command is available for repeated formatting jobs such as form letters. An external editor is required as no editing functions are included. The TSC Text Processor resides in just over 8K beginning at 1000 hex plus filespace. $32.00 buys the full manual including an "Introduction to Text Processing," user's guide, and fully commented assembled source listing. An Intel ASCII-format paper tape is available for an additional $9.00.

Technical Systems Consultants, Inc., Box 2574, West Lafayette, IN 47906.

CIRCLE 235 ON READER SERVICE CARD

APL/Z80

APL/Z80 is an APL system for the Z80 microprocessor. Version 1 has nearly all of the functions, operators, and features of APL on a large system. Functions not implemented in Version 1 are transpose, monadic format, matrix inverse, matrix divide and inner product. These are easily implemented with user-defined functions, however. APL/Z80 consists of two modules known as the supervisor and the interpreter which is romable. The supervisor handles all interfaces with the Z80 computing environment. The Version 1 supervisor is designed for the Digital Group Z80 system and features a cursor-driven editor which is active at all times when input may be received from the keyboard. In addition the last line input may be recalled for editing and re-entry to the APL systems. An APL character-set ROM using the Motorola MCM6770 character generator will be available as an option.

Vanguard Systems Corp., 6812 San Pedro, San Antonio, TX 78216. (512) 828-0553.

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*Suggested retail price. Does not include video monitor or cassette recorder.

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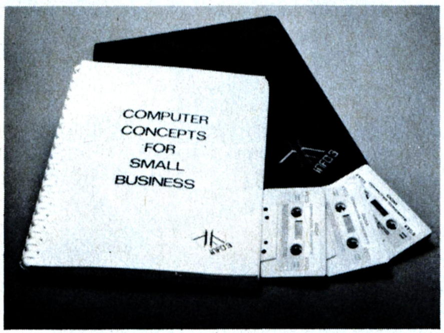
MISCELLANEOUS

MPU VIDEO GAME

Magnavox has introduced its first microprocessor home video game unit, The Odyssey² Computer Video Game System (Model 7600). The new game features a 49-position alphanumeric keyboard which will enable the user to engage in beginning computer programming as well as play a wide variety of electronic sports, combat, and logic games on their television screen. Nine pre-programmed cartridges will be available initially for the Odyssey² with one cartridge included with the game unit at time of sale. Seven of the optional cartridges will have a suggested retail price of $19.95. The eighth cartridge, Computer Introduction, will carry a suggested list price of $24.95. The Odyssey² is $179.95.

Magnavox, 1790 Magnavox Way, Fort Wayne, IN 46804.

CIRCLE 237 ON READER SERVICE CARD



COMPUTER COURSE FOR FIRST-TIME USERS

A self-instructional course providing information needed by first-time users of computers has been announced by INFO 3, publishers of audio-cassette EDP courses. *Computer Concepts for Small Business* covers basic computer concepts, including types of data and how they are processed, how systems are developed, the operation of implemented systems and how to select a computer. A chart showing Goals, Objectives and Tasks for this course, called a GOT Chart, is available free. It shows in detail the learning sequence and the measurable skills derived from the course. The course is designed to aid business people to prepare for their first computer, by presenting the prerequisites of sound business computer applications, showing how systems are developed and operated, and covering critical management decisions like security and personnel staffing. Also, specific steps are described for evaluating and acquiring computer equipment and software. The course contains over two hours of instructional audio-cassette tapes, plus a workbook of over 200 pages. The regular price is $145, but an introductory price of $95 will be in effect through September 15, 1978.

INFO 3, 21241 Ventura Blvd, Suite 193, Woodland Hills, CA 91364. Toll-free number is (800) 423-5205; in California (213) 999-5753.

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APPLE USERS GET ACCESS TO STOCK-MARKET QUOTES

Apple Computer has a new service which will provide owners of its computers with stock portfolio information and other financial services. Using a telephone link up, users of Apple II Computers will be able to dial the Dow Jones Stock Quote Reporter Service for fifteen-minute-delayed stock and bond quotations. This information along with software provided by Apple will enable the user to determine current portfolio value, short and long term gains, and rate of return, among other things. At a later date, Apple II users will be able to call up current news on companies in their user's portfolio. The cost of the stock quote service will include a one-time fee of $25 plus a usage charge of $3 for the first three minutes plus 50¢ a minute thereafter for each usage session.

Apple Computer Inc., 10260 Bandley Dr., Cupertino, CA 95014. (408) 996-1010.

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Casio, Inc., 15 Gardner Rd., Fairfield, NJ 07006.

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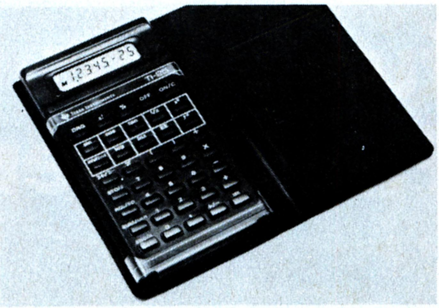
CANON SCIENTIFIC AND STATISTICAL CALCULATOR

The Canon F-62 is an advanced hand-held scientific and statistical calculator. It has 10 digits, 1-memory, 8 digit mantissa and 2-digit exponent. Versatile scientific functions contain: hyperbolics and their inverse, polar and rectangular conversion and more. Advanced statistical functions contain: factorial, permutation, combination and probability, areas under normal distribution curve, and more. Long battery life provides about 1,200 hours continuous use. List price, $59.95.

Canon USA Inc., 10 Nevada Dr., Lake Success, NY 11040.

CIRCLE 241 ON READER SERVICE CARD



TI SLIMLINE LCD SCIENTIFIC CALCULATOR

The Slimline TI-25, which combines state-of-the-art features and attractive slimline styling, is announced by Texas Instruments. The new electronic scientific calculator, designed for professionals and students, provides versatile, built-in capabilities for handling algebraic, trigonometric and statistical problems.

The TI-25, with an easy-to-read Liquid Crystal Display (LCD), will automatically handle a broad range of mathematical problems, including such slide-rule functions as roots, powers, common and natural logarithms, reciprocals, and trigonometry—in degrees, radians and grads. Functions such as pi and factorial provide rapid calculations for use in complex problem-solving, while a scientific notation key enables a user to work with small or large numbers with ease.

Powerful built-in statistical capability quickly computes mean, variance, and standard deviation—giving immediate access to numbers needed to analyze data and draw conclusions.

Another built-in feature in the TI-25 is the algebraic hierarchy with three levels of parentheses. This allows users to enter problems as they're usually written, left to right. It eliminates the need for rearranging formulas or equations and scratch-paper calculations. $30 suggested list.

Texas Instruments Inc., Consumer Relations/TI-25, P.O. Box 53, Lubbock, TX 79408.

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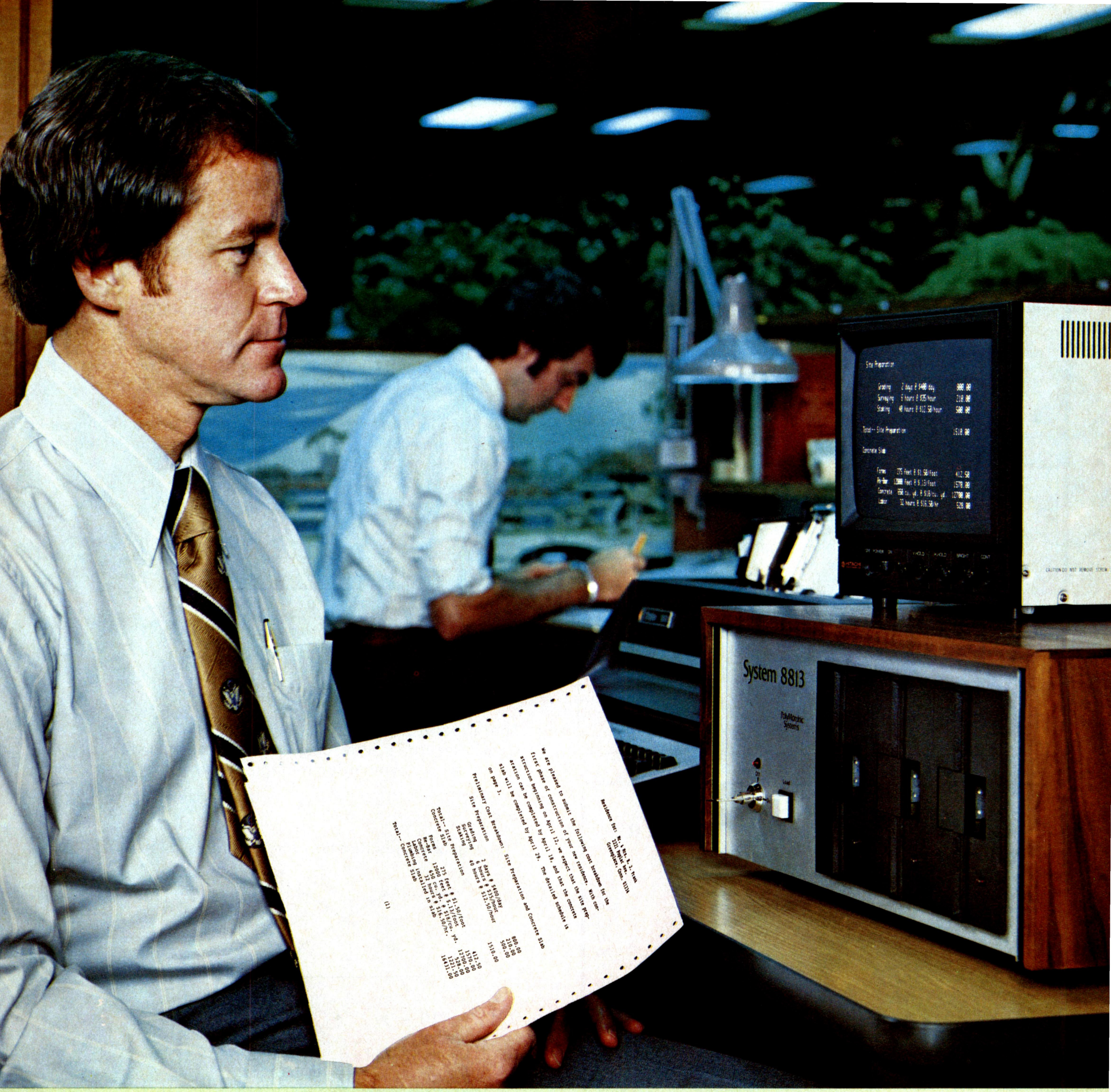

The Computer for the Professional

The 8813 was built with you, the professional, in mind. It quickly and easily processes cost estimates, payrolls, accounts, inventory, patient/client records and much more. You can write reports, briefs, and proposals on the 8813's typewriter keyboard, see them on the video screen, and instantly correct, revise, or print them.

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9.	Income Tax — 1040, Schedules A & B	25
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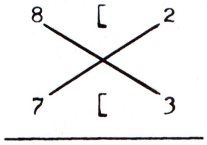
CIRCLE 166 ON READER SERVICE CARD

THE ORIGIN OF THE TIMES SIGN?

John F. Rogers

The earliest use of the word *algebra* in English occurs in PATHWAY OF KNOWLEDGE (1551) by Robert Recorde (1510?-1558), of England's Oxford University. But of particular interest are the devices Recorde proposed for the painless use of Arabic numerals, then coming into vogue.

For example, one need learn multiplication facts only as far as 5 times 9 if one chooses to multiply by Recorde's method. Using 8 times 7 as a guide:



(10 - 8 = 2)

(10 - 7 = 3)

(7 - 2 = 5)   5   6   (2 times 3 = 6)

or

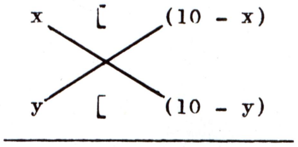
(8 - 3 = 5)

Therefore, 8 times 7 = 56.

Could Recorde's little diagram be the origin of X as a symbol for multiplication?

* * *

The algebraic justification for Recorde's method is:



$$10[x - (10 - y)] + (10 - x)(10 - y) =$$

$$10[x - 10 + y] + (10 - x)(10 - y) =$$

$$10x - 100 + 10y + 100 - 10x - 10y + xy = xy .$$

John F. Rogers, Morgan City High School, Morgan City, LA 70380. ■

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As you know, if your tape heads are dirty, you lose frequency response. A rough tape surface causes virtually the same effect as dirty heads. It prevents intimate tape head contact with the main body of the tape. When tape is coated, it has millions of microscopic peaks and valleys. Calendering eliminates the peaks and valleys, causing a very smooth surface. In addition, since there are no rough peaks, there is less oxide ruboff and less head wear.

Calendering is just one of the many high quality features you'll find in Creative Computing Software cassettes. We could have purchased cassettes for half the price that would have worked, but we wanted to be sure that our cassettes would last for years and would give you an error-free program load *every* time.

Rather than rush our software to market, we've paid attention to tape quality, the cassette mechanism (it *won't* jam), redundant recording, and packaging (hard plastic box) as well as the programs themselves. With Creative Computing Software, you can be sure you're getting the absolute best that money can buy.

PET (8K) Software

CS-1001. Logic Games-1. Six favorites from *BASIC Computer Games* with super graphics. **Awari,** the African logic game with 12 pits and 36 beans. **Bagels,** which challenges you to guess a secret 3-digit number. Martin Gardner's **Chomp** in which you chomp on a cookie with a poison corner. **Flip-Flop**—change a row of X's to 0's. **Hexapawn** played with three chess pawns. **Hi-Q,** a solitaire peg-removal game. $7.95.

CS-1002. Number Games-1. Six number logic games including **Guess** in which you guess a secret number. **23-Matches**—try not to take the last match. **Letter** in which you guess a secret letter. **Number,** a random jackpot game. **Trap** in which you trap a mystery number between two trap numbers. **Stars** gives you stars as clues to the secret number. $7.95.

CS-1201. Education Simulations-1. Five super simulations including the popular **Animal** in which the computer learns animals from you. **Fur Trader** lets you trade furs in old Canada. **Hammurabi** in which you manage the city-state of Sumeria. Or try making your fortune in the **Stock Market.** A logic game, **Word,** has you guess secret words. $7.95.

CS-1003. Logic Games-2. Six challenging puzzles including **Rotate,** in which you order a matrix of random letters. **Strike-9,** try to remove all nine digits without striking out. The classic number game, **NIM.** In **Even-Wins** try to take an even number of chips. **Hi-Lo,** a number guessing game with a jackpot. **Batnum,** the super "battle of numbers!" $7.95.

CS-1004. Graphics Games-1. Five amazing realtime graphics games designed especially for your PET. In **Chase,** one player pursues the other through a maze of obstacles and "zap doors." **Escape**—attempt to escape from a prison patrolled by robot guards. **Dart** provides arithmetic drill and indicates how close your response is to the correct answer on a dart board. In **Snoopy** you compute distances on a number-line while trying to shoot down the Red Baron. In **Sweep** you must try to hit nine targets in order by controlling the path of a cannonball. $7.95.

CS-1005. Graphics Games-2. Six favorite games. **LEM,** lunar lander with a graphic display and optional auto-pilot. **Nuclear Reaction,** a game of skill for two players. **Artillery,** in which two players shoot it out over computer-generated terrain. **Bounce** traces the path of a ball bouncing around the screen. **Checkers,** with graphic display, from our *BASIC Games* book. **Dodgem,** try to outmaneuver another player or the computer to get your pieces across the board first. $7.95.

CS-1006. Conversational Games-1. Talk to **ELIZA,** the computerized psychoanalysis program. Compose poetry with **Haiku.** Challenge your vocabulary and word-guessing skills with **Hangman. Hurkle,** try to find the hurkle on the 10 by 10 grid in five moves. In **Hexletter,** you compete to capture more letters on a hexagon than your opponent. $7.95.

CP/M Software

CS-9001. Games-1. An 8" floppy disc containing most of the first **fifty** games from *Basic Computer Games* in Microsoft Basic. All the games from **Acey Ducey** to **Hi-Q** including such favorites as **Animal, Bullfight, Craps,** and **Hangman.** (To run this, you need CP/M and Microsoft Basic.) $17.95.

CS-9002. Games-2. The second half of Basic Computer Games including **Life, LEM, Mugwump, Stars, 23 Matches, Word,** and **forty** more! 8" floppy disc. $17.95.

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Or you can order directly from Creative Computing. Send your check for tapes plus $1.00 shipping and handling per order to Creative Computing Software, P.O. Box 789-M, Morristown, NJ 07960. NJ residents add 5% sales tax. Visa or Master Charge are acceptable also. For faster service, call in your bank card order toll free to 800-631-8112. (In NJ, 201-540-0445).

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Exidy Sorcerer

Margot Critchfield

To say that the personal-computer field is a changing one is a record understatement. The variety in new components can be bewildering. However, the novice buyer can keep pretty well abreast of things by concentrating on complete systems. In particular, it's worth keeping an eye on three things: the features of systems that continue to prove themselves as solid citizens of the micro world; the reasons why some old friends have bitten the dust; and the promise offered by new faces on the scene. Of special interest are new systems with a design philosophy that makes one take notice because there is a capability for growth in several directions.

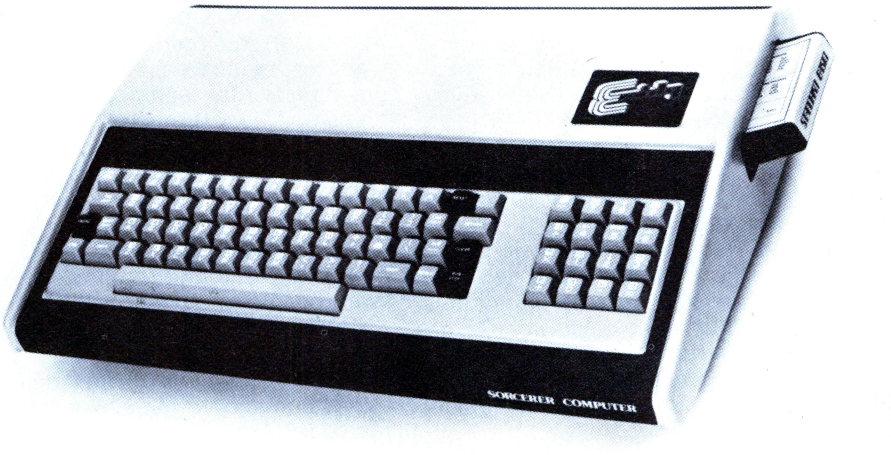
One entry in this last category that attracted much attention at the 1978 NCC Personal Computing Exhibit at Anaheim was the Sorcerer computer. It's a relatively low-cost (about $895) computer being built by Exidy, a company that has been active in the "arcade game" field prior to this. The thing that distinguishes Exidy's entry into the personal-computing market is that they elected *not* to introduce a home game center that could ultimately be converted into a programmable computer. Instead, they have designed a full-fledged microcomputer system that can be expanded in a number of directions (including—for those who wish—games utilizing good resolution graphics, both black-and-white and color).

The initial Sorcerer configuration is a unit that measures 19 x 13 x 4 inches, and weighs 13 pounds. As shown in the photograph, it looks like an expanded keyboard enclosure (somewhat larger than the Radio Shack TRS-80). Protruding from the right side is a removable cartridge that has the appearance of an eight-track tape cartridge, but which is actually a removable "chunk" of memory. It can hold up to 16K of ROM, and it's used to store any kind of "permanent" software that might be desirable now or in the future. The Exidy trademark for the cartridge is ROM-PAC. The main use of this facility will be to provide systems software (such as a BASIC interpreter, a Z-80 assembler, APL, DOS, and a word processor). The obvious advantage to this approach is that users don't have to argue about which language or facility is best—they just plug in the software of their choice. They can also create their own, since an EPROM-PAC will also be available.

The CPU uses the Z-80 chip. The standard unit comes with an 8K Microsoft BASIC in a ROM-PAC, and an additional user 8K of RAM memory which can be extended to 32K within the basic unit. The standard interfaces included are an RS232 serial I/O port, a parallel 8-bit latched and buffered I/O port with handshaking, a dual cassette interface, and an edge connector that permits adding an expansion box. The power of the expansion box is that it uses the S-100 bus, so all the goodies now available for this standard can theoretically be added to the Sorcerer. This means that voice synthesizers, A/D and D/A converters, graphics, additional I/O, and additional memory can be part of a full-fledged system. In particular, Exidy is developing a set of two S-100 boards that will provide high-resolution 8-color graphics (256 by 256 addressable points with colors individually selectable for each point).

The standard output display is capable of providing both alphanumeric and graphic information. The alphanumeric display comes out the back as composite video ready to go to a black-and-white TV monitor, or into a high-resolution unit Exidy sells (for about $250). Up to 30 lines of 64 characters each can be displayed on the screen, including the full ASCII upper- and lower-case set, 64 special graphics characters, and (get this) an additional 64 special characters that users can define with software (music buffs take note). In graphics mode, this same display allows black-and-white graphics with a resolution of 512 (horizontal) by 240 (vertical). The standard unit also provides for two user-supplied tape-cassette units (with motor control). Disk drives can be added through the expansion box, and Exidy will be selling a companion disk unit that uses Shugart drives.

These are impressive specs, and they show an above-average amount of planning, particularly with regard to both hardware and software growth. A report on how these specs stack up in practice will be in the works as soon as the first evaluation units become available. ■



Margot Critchfield, University
of Pittsburgh, Pittsburgh, PA 15260.

Random Ramblings
Random Ramblings
Random Ramblings
Random Ramblings

David H. Ahl

These last few months have been nothing short of incredible in the consumer electronics industry and at *Creative Computing* as well. I'd like to share some of my observations with you, first about *Creative,* then the industry, then a couple of other things. For information on any of the products mentioned, reader service card numbers are on page 41.

Staff Changes

Those of you who read our masthead and others areas of fine print may have noticed some changes, in particular, that we have a new editor, **John Craig.** John has been in the computer industry for many years with Varian Data Machines and Federal Electric and has a rich background in both large and small systems, software and hardware, but most of all he has the unique ability to communicate his knowledge through the written word in a clear, concise, and interesting manner. John was co-editor of the *Micro-8 Newsletter* back when people were building computers from 8008 chips (only two years ago, but it's like ancient history). More recently, John was the editor of *Kilobaud.*

This issue was put together by the existing team, but you'll start to see John's hand next issue. Speaking of the existing team, you'll continue to see reviews, TRS-80 stuff and more bylined articles by Steve Gray in his new role of associate editor. Steve also will be doing some free-lance work for other publications both inside and outside of the computer field.

Other new names in the associate editor column include the following:

Lee Felsenstein was born in Philadelphia and grew up wanting to be an inventor. Outside of that, he bears no resemblance to W.C. Fields whatsoever. Instrumental in establishing the first experimental public-access information-exchange system in 1972, he is presently engaged in further development in that area of communications. In his spare time he has designed the Pennywhistle 103 modem, the VDM-1 video display module, the SOL terminal/computer, and the VID-80 video display card. Lee was also instrumental in forming the original Homebrew Computer Club and currently serves as its "toastmaster."

Bill Etra is a West Coast-based computer design consultant. He is coinventor of the Rutt/Etra Video Synthesizer — the first portable voltage-control analog video synthesizer, as well as the Video-lab. His main interest is videographics, and many of his works have appeared as cover illustrations on various periodicals and books including *Computers in Society* and *Broadcast Management and Engineering.* His current research centers on "The Computer as a Compositional Tool for Video."

A.I. Karshmer is currently completing his Ph.D. in computer science at the University of Massachusetts. His main interest is the use of artificial intelligence concepts in solving problems involved in the transmission of computer graphics. Currently, he is developing a method for sending high-density information, such as animated graphics, over existing low-bandwidth telecommunications networks.

Theodor Nelson is the author of the classic *Computer Lib/Dream Machines,* a Whole-Earth-style catalogue of computer machinations. His latest book is the newly released *The Home Computer Revolution.* Ted specializes in highly interactive systems for graphics and text. His past experience includes a stint at Dr. Lilly's Dolphin Laboratory and work as a consultant for Bell Lab's ABM system.

Eben Ostby has been involved with computing ever since he crashed the PDP-8 at Pomfret School. At present, he is doing graduate work in computer science at Brown University and trying to convince people that APL isn't really all *that* bad.

Frederick W. Chesson is a graduate of the University of Connecticut. After work in electronic engineering, he gravitated into technical writing. At present, he furnishes instruction manuals and related items to various firms plus construction articles to several electronics hobby magazines. A member of the American Cryptogram Association since 1958, he is currently researching a book on Civil War codes and ciphers.

Robert Osband took apart his first telephone at age twelve, and hasn't stopped playing with them since. As a Communications Center Specialist for the U.S. Army in Germany, he expanded his knowledge of information transmission and his scope now ranges from the Voice Telephone Network through the Inter-University ARPANET, to the International Telex Network.

Ed Hershberger is a New York-based film-maker and friend of technology, ecological balance, high-fidelity, and good soldering technique. He can be found working on movies, breadboarding circuits, or perusing Canal Street for servos, transformers, and sockets for his various projects. Currently, he is working on a portable, zero-voltage switching clock to turn battery-belts on in various motel rooms.

Margot Critchfield has been associated with Project SOLO and Soloworks at the University of Pittsburgh as editor, illustrator, and researcher. She has collaborated with Tom Dwyer on his recent book *Basic and the Personal Computer* and numerous other articles and booklets. She is currently finishing up her Ph.D in Education at Pittsburgh.

There are a number of changes and additions in other positions as well who I'll introduce to you next issue.

As many of you know, *Creative Computing* was a "hobby" for me whilst working full-time as Manager of Marketing Communications for AT&T. Well, no more. I am now at *Creative Computing* full time.

With Love to
Creative Computing
Barbara

Pethouse Pet Barbara Corser sends greetings to Creative readers from the Consumer Electronics Show.

"Not Just a Magazine"

Many of you know *Creative Computing* mainly as a magazine. However, only about one-third of our corporate revenues are derived from the magazine. Other divisions include:

Creative Computing Press. Our book publishing arm, Creative Computing Press, started by publishing material reprinted from *Creative Computing* magazine. We now publish a wide variety of original books related to computer applications in education, small business and the home. We publish approximately six new titles a year along with a line of board games, posters, prints and T-shirts. These books and other items are sold by mail order, and through retail computer stores and selected college and trade book stores.

Creative Computing Book Service. Our mail order book service handles a wide selection of publications of both major and small presses. In addition to computer applications, titles cover computer literacy, problem solving, games and puzzles. Many of these books are not readily available in retail stores.

Creative Computing Software. Our newest division, Creative Computing Software, is involved with developing and marketing software for home, small business and educational computer users.

Creative Computing Consulting. Principal clients are educational institutions and computer manufacturers interested in the education market. On these assignments we draw not only on our own staff but many collaborating educators and researchers as well.

Overview of the Consumer Electronics Show, June 11-14, 1978, Chicago, IL.

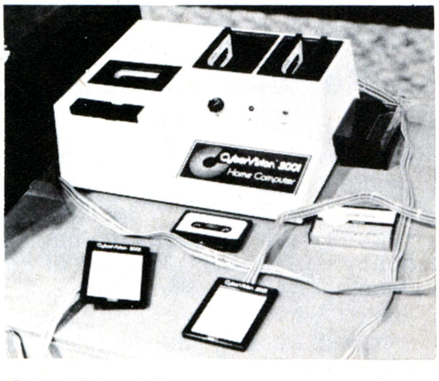
Consumer Electronics Show

Those of you who read my May editorial will recall I predicted that more new computers would be announced at the Consumer Electronics Show (CES) than at the National Computer Conference (NCC). The score: CES 7, NCC 1. Not a bad prediction! I also said we'd cover the CES and I did — personally. NCC too, for that matter. Here are some of the highlights from the CES (most of these items are or will be covered in greater depth elsewhere on these pages).

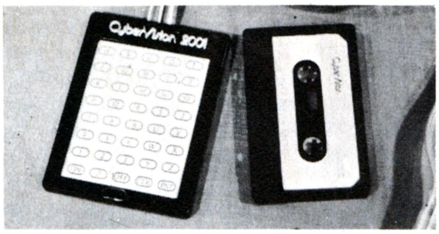
Personal Computers

PeCos I personal computer. Console contains a full 60-key keyboard, MPU (6502), 24K ROM and 16K RAM, two cassette decks and I/0 provision for two more (nice for sort merging) and an RS232-C output (for printer or external terminal). A 9" B&W monitor, 40 characters per line, 16 lines is included with the basic system. The program language is PeCos, a derivative of JOSS (a list processing language developed by Rand Corp). It's made by APF Electronics who are leaders in printing calculators so the aim is probably more small business than home or educational use.

CyberVision 2001. Console contains MPU, 4K RAM, single cassette deck and built-in speaker. Two alphanumeric touch sensitive keypads are included. The unit attaches to a color TV set. It runs Tiny BASIC but most of the preprogrammed cassettes are in machine code. Because of the relatively small built-in memory, programs use continuous overlays; i.e., keep the cassette running, but this introduces some neat possibilities with the separate audio track — storytelling, spelling and language drill and audio prompts in programs. This is the unit sold through the Montgomery Ward catalog. (See interview with John R. Powers III.)



CyberVision 2001 uses stereo cassette tape with one track for programs and one for audio.



CyberVision 2001 control has full alphabet and numerals on touch sensitive pad.

Ohio Scientific was showing their complete line at both the CES and NCC. Interest seemed most keen on the $598 Challenger IIP with 6502 MPU, built-in keyboard 8K BASIC in ROM, 4K RAM and video output (to a monitor) of 32 lines x 64 characters. Cassette recorder is external.

VideoBrain showed their Expander 1 (for two external cassette recorders) and Expander 2 which is an acoustic-coupled telephone modem to make VideoBrain into a timesharing terminal. Six new cartridges in financial management, entertainment, and other areas were also introduced.

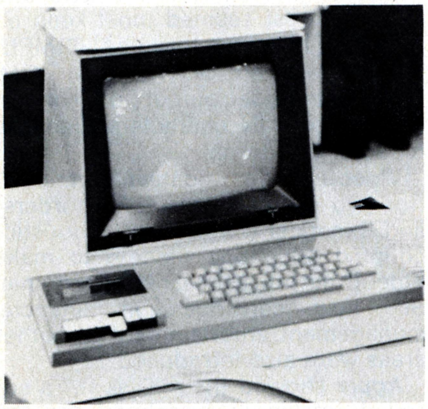
Apple showed their "Disk II," a so-called intelligent peripheral for the Apple II. It was being demonstrated most impressively with stock price data from the New York Stock Exchange. The disk offers random and sequential access, 116 kilobytes per diskette in a 35-track soft-sectored format. Each track contains 13 sectors of 256 bytes each. Price is $495.00 Apple also reduced memory and system prices substantially.

Apple, by the by, is putting a tremendous amount of money in their

Ramblings Con't....

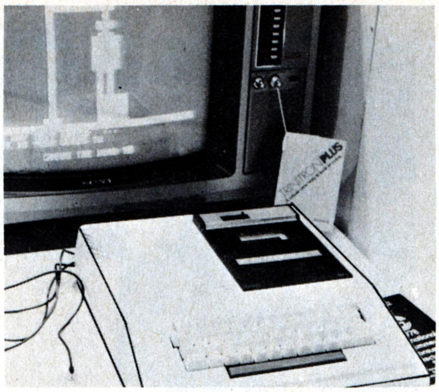
manuals and documentation at both the user level as well as the dealer level. Their new basic programming manual, which they were giving out as a promotional piece, is 130 pages and is extremely well done. It's two-color throughout and four-color on many of the pages. This is a parallel, in a sense, to what Digital Equipment Corp. used to do when they gave out their Small Computer Handbook for the PDP 5 and the PDP 8. The idea being, let the consumer know how easy it was to use the unit and then they will go on and buy it.

Teal Industries showed the *Swift Personal Computer.* The Swift outwardly resembles the PET; that is, it has a keyboard and CRT and the computer built into one unit.On the other hand, its actual electronic characteristics are identical to those of the Radio Shack TRS-80 computer. It uses a Z-80 chip as the central micro processor, has a standard keyboard, 12-inch black and white screen, and single data cassette built in. The screen displays 16 lines of 64 characters each. The basic unit has 4K bytes of read only memory (ROM) and 4K bytes of RAM. It's imported by Teal Industries, Inc., Victoria Business Park, 251 East Victoria St., Carson, California, 90746. The word is from the Teal folks that they are looking to produce a private-label version of this computer for all comers. The price of the Swift in lots of 300 or more, FOB Japan is $257.00. That should mean a selling price, after mark-up, transportation and import duty, of around $650.00.



Home computer by Teal Industries looks like a PET but runs TRS-80 software.

Another "look-alike" unit is manufactured by **Toshiba** which is essentially an electronic imitation of the Apple computer, although outwardly it looks more like the Processor Technology SOL or Ohio Scientific Challenger. Apparently the Toshiba unit will not be commercially available in this country until December or later.



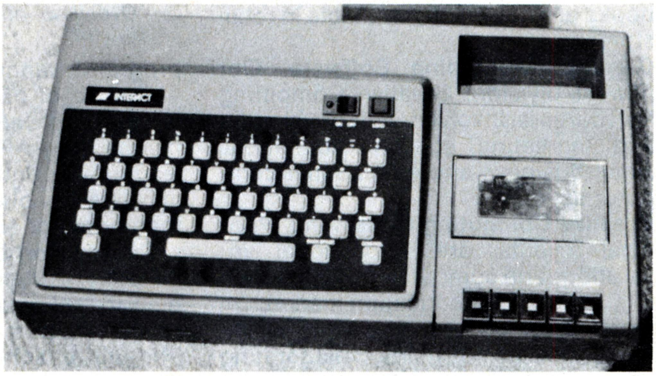
"Home Wizard" computer from Hong Kong carries a $420 wholesale price tag, F.O.B. Connecticut. Retail should be around $695.

Under the **"Home Wizard"** electronic product line was an entry simply called Home Computer by EAP Electro-Atomic Products, Ltd., Flat B First Floor, Kan Bun Industrial Building, 13-19 Kwai Wing Road, Kwai Chung, N.T. Hong Kong. The Home Wizard Home Computer has a tape cassette built into it, a full 50-key keyboard and appeared to have reasonably good graphics on the screen with text output of 16 lines of probably 40 characters each, although there are no printed specs. The unit supposedly was a 6500 family MPU but not a 6502. Curious. Looks like an Apple to me. It's unlikely that it's being manufactured at this time and the unit that was shown at the show was simply a prototype to gauge dealer reaction to the product.

Still another personal computer system is called the **InterAct Personal Computer** manufactured by InterAct Electronics, Inc. It has a 48-key standard typewriter keyboard layout, however, the keys are more like calculator touch-sensitive keys. Also built in is an audio cassette recorder. More details were unavailable at press time.

Commodore showed the new printer for the **PET**, which prints 80 characters per line on roll paper 8½" wide and reproduces all the PET graphics symbols. Very nice. They also showed an

Interact computer won a design award at the CES.



Personal Computing: The Size of the Market

According to the *Consumer Electronics 1978 Annual Review* produced by the Electronics Industries Association, "the home computer market is currently dominated by enthusiastic hobbyists, and it's expected to continue to be this year. Sales will be limited by production, industry members believe, and will total about 250,000 units in 1978."

The statistical and marketing forecast prepared by *Merchandising* in May 1978 predicted a somewhat smaller 180,000 units in 1978.

What has already been delivered (by mid-year 1978) in the three years since the first Altair was shipped by MITS? Apple's public position is that they have shipped more than number two and three together, who are PET and Radio Shack, although not necessarily in that order. There is general agreement from both inside and outside Commodore that 15,000 PETS have been shipped. Current deliveries are running 3,000 - 4,000 per month and are expected to be 10,000 per month by years end. Estimates of TRS-80 shipments to date vary between 8,000 and 20,000 which indicates that Apple (who are extremely secret about their sales) has sold about 25,000 units. Mike Scott, president of Apple, told me that their sales in the fiscal year ended September 1978 would be between $10 and $20 million. Translating this to units indicates a unit volume between 13,500 and 27,000. Sales of everyone else put together over the past three years is probably in the neighborhood of 75,000 to 100,000, hence in the first three years of personal computing, approximately 150,000 units have been delivered.

So, 1978 will see deliveries of 1.2 to 1.7 times the total sales of the first three years. Anyone want to guess what sales will be by 1980? By 1985?

Ramblings Con't....

external cassette drive capable of storing 170 kilobytes. Price $100.

Intelligent Systems Corp. again had everyone drooling over the spectacular color graphics on their Compucolor line but delivery is still the big question as it has been since first showing the products in March at the West Coast Computer Faire.

Bally, of course, showed the professional Arcade which is reviewed elsewhere in this issue.

A high-end new entry is the **Smarts II** from **Fire Bird Sales Company,** P.O. Box 116, Woodland, Illinois, 60974. It has 32K of RAM built into it with an expansion capability to 630K of RAM. It also has a mini floppy disc drive built into it which can be increased to 3 drives as the need dictates. It provides output on a CRT display which is not included with the basic unit, 16 lines of 64 characters each. It also has provision for controlling color. The CPU in the Smarts II is a Z-80, actually a Mostek 3880, but nobody's ever going to know. The price on the Smarts II is $1,695.

Technology: VLSI Around the Corner

Those ingenious engineers who gave us integrated circuits, then followed that bit of magic with large-scale integrated circuits, are about to pull another rabbit out of their hats. The latest wizardry is something called very large-scale integration (VLSI), and application of VLSIs to consumer electronics could make even the most sophisticated products now coming along look like Tinker Toys.

Among the possibilities? How about a pocket calculator-device with an alpha keyboard and a full foreign-language dictionary in its memory. Or home computers with vastly expanded capabilities over those currently on the market. Or even a small voice-recognition device which links directly to a computer.

Just what is VLSI? The original integrated circuits (ICS) put 15 to 20 transistors on a chip; large scale integration (LSI) jammed 500 transistors on a chip. Now comes VLSI with the promise of more than 5,000 transistors on a chip. The first VLSI chips will go to the big computer companies but it won't be long (2 years?) before they'll be available in consumer products.

The one possible drawback is that these circuits apparently can't be made with good old standby silicon, but must use gallium arsenide. This isn't a strange, new material; the industry has been using it for high-speed and high-frequency semiconductors for years. Now they're going to use it for VLSI. But unlike silicon, gallium arsenide can't be made to support higher operating temperatures. This means that no power output circuits can be made as part of a VLSI chip, and in fact if there's much heat involved—such as in the power output of an audio amplifier or of a CB transmitter—the output transistors not only have to be separate, discrete devices, they must have good heat isolation from VLSI circuits.

"The Home Computer: A Tool Not A Toy"

An Interview with Mike Scott, President, Apple Computer Inc., Cupertino, CA.

Ahl: I've heard it said that over the next two years the distribution channels will be the name of the game. Anyone can build the hardware — the Japanese, Koreans, Hong Kong people and so on. But sales support and software support is a more difficult game. How are you looking at this at Apple?

Scott: We have two-step distribution, meaning a regional distributor that supports a regional area of stores, say like 60 stores. He's able at least once a month to visit all the local stores, able to communicate to them the latest new product available, how to sell it, and service it.

Ahl: And service takes place at the regional level?

Scott: Yes. But the service is also explaining to the guy how to sell the product. Everybody's got a pitch on why a computer is good. But when a customer comes in the door, how do you effectively minimize your sales time? You want to be able to close that sale without having the salesman spend eight hours and then maybe lose the sale. So, we're spending a lot of effort on the advertising to get the people into the regional stores or in the local stores to get that local support. Let's say a year or two out when there's 100,000 or 200,000 users and they have a technical question, they can't call the factory. We just can't have enough phones. So they have to be able to go back to their retail store where they bought it to get the service.

Another thing — I think both PET, Radio Shack and ourselves are following a premise that once a guy buys the initial computer, over the next year or two he'll come back and spend at least an equal amount buying accessories and peripherals. So there is an after-market automatically built in. And again, you need a local store rather than mail order where the customer can go select his add ons.

Ahl: Are you looking at stores like the discounters and the mass-market merchandisers?

Scott: We do not do any business through catalog or discount mass-merchandising chains. We want to be able to have a higher margin and the sales support that you can get from a one-on-one sales relationship that is necessary to sell at $1,000 computer.

Mike Scott of Apple Computer

Ahl: You're not interested in, let's say, a Macy's or a Bloomingdales.

Scott: We're going to do test markets over the next six months to understand what kind of point-of-purchase sales aids you need to be able to sell in those stores. We started last September with Team Electronics, which is an example of a hi-fi chain, to start understanding how to sell through those stores.

I think another change is going take place. Right now 80% or more of the people that are buying home computers already know something about programming and do programming themselves. Two or three years from now that percentage is going to reverse; 80% are going to want pre-canned programs. That's because they're lazy. They want to turn on and have it come back and say, like the H&R Block guy does, "Answer these questions and I'll tell you what your taxes are." So it's not really user-programmed in that sense. The factory has a software base on it. But it still is adaptable at the home level and once you get into it, you could modify the programs a little bit.

Another important thing is to get enough people thinking that it's not just a toy. This is where the games started them thinking. And Apple helps encourage it a little bit. You start with it because it's a toy. But we've got to start getting people thinking of it as a tool.

Ramblings Con't...

Chuck Peddle, designer of the Commodore PET.

Home Computers: The Name of the Game is Peripherals

An Interview with Chuck Peddle, designer of the Commodore PET

Ahl: There is a rumor that all of PET's being made are going overseas.

Peddle: During the first half of June 1978, we shipped exclusively overseas but that was planned because of the holidays in Europe. Europe tends to almost shut down business in July and August. So the intent was to load them up before that. We'll catch up with the U.S. dealers in July and August. Then we can start adding new ones. Admittedly, we haven't kept all of our U.S. dealers as happy as we would have liked but we've done what we can.

Ahl: What do you think of the Exidy Sorcerer?

Peddle: I think it's a legitimate attempt to keep the S100 bus alive. That seems to be the only major difference between it and two or three others. Actually, I think that they're a little late for the hobbyist market. But if you look at their backers, I understand where they're coming from and to them it makes sense. I've talked to several dealers and they're going to carry it because of the Z80, and they're trying to get the Z80 freaks. So maybe that's it.

Ahl: In the mass market, who's going to differentiate between the Z80 and 6502? It seems to me that software is the crucial element now.

Peddle: No. I don't think so. I feel that the next round of competition is the area of peripherals. I think we and Apple, particularly, and Ohio Scientific, are out there fighting peripherals in this show (CES). None of us are introducing new computers, we're introducing new peripherals. That's where the battle is. Maybe software too. But I think the software is going to be generally available to everybody. So I think what you do in peripherals is the major factor.

"The Home Computer Market: It's Not Here Now"

An Interview with Arnold Greenberg, President, Coleco, Hartford, Conn.

Greenberg: The home computer market in part has been a creature of the trade press which got a whiff of advanced technology and by building it up and building it up led the world to believe that the market is here now. It's not here now. It will be here soon. Right now the only market out there is a hobbyist's market. The marketing challenges haven't been solved. The technology is well ahead of the market. And until we can make compatible both the marketing with the technology, we're not going to have something at a popular price that's going to do something for the consumer. $500 or more home computers are not the answer to anybody's mass market.

Ahl: So you think Fairchild and Atari may be taking or getting into things a little bit ahead of time?

Greenberg: They're not into it. Atari has said that they are not interested in a home-computer market at that price point. They're not into it nor is really Fairchild.

Ahl: In other words, those are just games.

Greenberg: That's right. And what we want is something more than a game. It's got to do more than entertain. It's got to educate as well and be functionally significant to the owner. But we don't want a sophisticated hobbyist item or a small-business computer. That's a wholly different market.

Ahl: So APF is probably out on a bit of a limb now with their little entry here.

Greenberg: Well, it's a very lovely item. I think their market is a small-business market. And I think they're looking at that very directly. They're in the small-business equipment field, they do a very good job in calculators. But that's not a mass-market item.

Ahl: Right. Where dc you see yourself going in the video-game market?

Greenberg: We see ourselves expanding; we think we'll continue to be the number company with primary emphasis on the low end. Absolutely, that's where the mass market is. The low end. Remember, we are mass marketeers. We entered this industry not from an electronics distribution base but from the traditional toy and game industry. We're interested in selling hundreds of thousands of units of an item. We're not interested in a limited distribution or 20 to 25,000 unit runs of anything. It's a very big difference.

Reliability and Mass Production

A word to the wise: don't expect that new $700 computer to be as reliable as a $700 Sony or Technics hi-fi receiver. Assembly lines for computers are new. DEC and DG come as close as anyone to having mass assembly lines for their minis; in both cases their computers spend more time in checkout, burn-in and quality control than the rest of the line together. Some of the new manufacturers haven't faced up to this yet. Furthermore, engineering changes are being made daily which further complicate any kind of mass production.

Case in point. Commodore has used four different cassette mechanisms in the PET in the first nine months of production. Each of them required changes in the mother board. Consider the problems then if you have a problem with the cassette recorder in your PET, as we did. The local service center puts in a new mechanism but finds it incompatible with the mother board. What then? Modify the mother board? Try to find an older mechanism? (As of this writing, our PET has made numerous trips to the Norristown, Pa. regional service center and may or may not be cured.) A conversation with one of the largest PET distributors reveals that 30% come through with the tape head misaligned. No problem if you're only reading and writing your own tapes, but what happens when you buy a commercial tape?

I do not mean to single out PET; I have no information to indicate that they are necessarily any better or worse than anyone else.

In general, the most frequent problems I've heard about over all manufacturers fall in two major areas: (1) cassette recorder, mostly head misalignment and (2) over-heating errors that occur after the computer has been on for some period of time.

Does all this mean that you shouldn't buy a computer yet? Not at all — just be sure about the guarantee and service arrangements. Hopefully you won't need either but ...

Ramblings Con't....

Magnavox programmable video computer game had full alphabetic and numeric keys on a touch-sensitive keyboard along with two joystick controls.

Programmable Video Games

The industry has labeled video games with a removable cartridge "programmable" although all the user can do is change the cartridge. I guess to some people this means programmable.

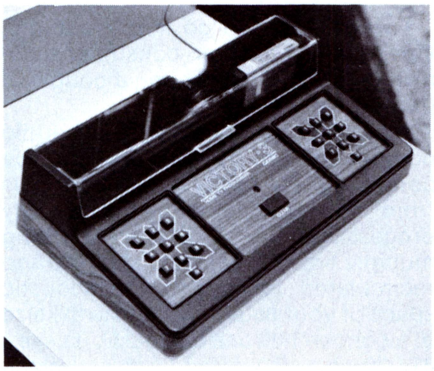
Unit sales of all video games in 1977 were about 4 to 4.5 million with 6 to 9 million forecast for 1978. Industry estimates indicate that 35% to 40% of these will be programmables and quasi-programmables. If what was being shown at the CES was any indication, it could be even higher than this.

Magnavox's Odyssey II marks the phasing out of all dedicated games by Magnavox and concentration on the programmable. Odyssey II has a 48-key keyboard of the touch sensitive variety along with two paddle controls. Eight cartridges are currently available. Inclusion of a keyboard in the basic unit indicates Magnavox is looking ahead toward a true programmable product, probably along the line of the Bally Arcade.

Fairchild Channel F System II uses a 16-button keypad as well as their unique (strange?) hand-held joystick controls. They boast 24 cartridges in their library yielding a total of over 1,000 game variations. I was particularly impressed with the checkers and blackjack cartridges.

Atari showed their **Video Computer System** along with its many cartridges and controllers (See July/August 1978 *Creative Computing* for a complete review).

APF introduced their **Microprocessor 1000** with combined 12-button keypad and 8-direction joystick controllers. No cartridges were available at presstime.



"Victory-3" video computer system from Conic (Hong Kong) had numeric keypads and user control of color and sound.

Accurate Electronics Industry Ltd. of Hong Kong introduced a rather unique programmable game under the **Conic** label. Five games (and several variations) are built in including a neat sketch pad game which gives the user control of video color as well as musical notes! After you get done with your drawing/tune, you can have the system repeat it endlessly with each image slightly displaced from the previous one. Nice built-in blackjack too. Controllers were numeric keypads.

"Programmable Tele Sports III" from Hong Kong will retail for $69 or so.

Radofin Electronics of Hong Kong introduced a programmable game, **Telesports III,** with two joysticks designed to retail at $69. Seven cartridges are promised in the initial offering most of which are variations of the popular coin-op or Atari games. However, at $69. ...

Olympos Electronic Co. of Korea entered the race with **Gamatic 8600,** another low-priced programmable. Two joystick controllers come with the unit; four cartridges are promised.

Two other entries in the price race are the Model 501 and 2003 programmables from **Video Technology, Ltd.** of Hong Kong. More of the same. At the manufacturer level, FOB Hong Kong, price of the 501 is $28, so it should retail here for $69 or so.

Also at the low end is the **Video Sport TCR-900 PC** imported by **Internet** of Beverly Hills. Two joysticks, nine cartridges promised, retail price of $69, cartridge retail $20.

Obviously, many of the last five games will be marketed under private

Programmable video game from Hong Kong will retail for $69.

Atari booth was continuously crowded with video-game junkies.

Ramblings Cont'....

or store labels. We'll try to include as much up-to-date information as possible in our Electronic and Video Games Roundup next issue.

After the Razor, then the Blade

Needless to say, once the programmable game is sold, the key to continuing business is the cartridge. As I pointed out in the review of the Atari system last issue, you could wind up spending two or three times as much on cartridges as the basic unit. Also, the cartridges are seldom discounted. Microtronix of Philadelphia even has a mail-order club for Atari and Fairchild cartridges with over 5000 members enrolled. Dealers like cartridges too since it helps smooth out the highly seasonal game business (90% of sales in the 4th quarter) throughout the year.

Smart Electronic Games

Logix Enterprises introduced a nifty real programmable computer called T.E.A.M. M.A.T.E. with a microprocessor, 20-key keyboard, 16-LED display, and audio speaker. Price $42.50.

Two electronic backgammon sets were on display: **Gammonmaster II** from Tryom, Inc. and **Computer Backgammon** from Texas Micro Games. Also two electronic chess games: **Boris** from Chafitz, Inc. and **Chess Challenger '10'** from Fidelity Electronics. Watch for a feature comparison of all these units in the November /December issue.

Mattel showed three new handheld games, **Basketball, Space Alert** (similar to last year's Missile Attack which has been withdrawn) and **Mind Boggler** (a bagels/mastermind type game) originally developed as Memoquiz by M.E.M. of Belgium. (Actually what we're really talking about is a handheld version of Milton-Bradley's COMP-IV — see *Creative Computing* November/December 1977).

Quasar robot. Girl at left is the voice; fellow in checkered jacket controls the motion via radio controller in a small airline bag.

Parker Brothers showed the musical **Merlin** and **P.E.G.S.; Milton-Bradley** had **Simon** saying, and there were several other entries originally rolled out at the February New York Toy Fair. **TI** had a new spelling calculator **'Spelling-B'** and a talking version with 234 difficult-to-spell words in its vocabulary called **Speak & Spell! National Semi** also had a spelling (but not speaking)calculator.

Watch for our "Electronic and Video Games Roundup" in the November/December issue for more on all these games.

Other Nifty Stuff

I won't begin to go into the audio, video, CB and other consumer electronics, except to mention a couple of exceptional items.

Advent Corp. introduced an audio component called the **SoundSpace control.** It derives two rear channels from a stereo system by digitally processing the signals and adding multiple time delays that are mixed and recirculated to expand the acoustic space of your listening room to the size of a concert hall or a cathedral. It uses a 32,000 bit RAM and crystal-clock CMOS logic circuits. It has two controls, size and reverberation. 'Size' controls delay time from 0 to 100 milliseconds, 50 being about 'right' to simulate a good size concert hall. 'Reverberation' determines the 'liveness' of the acoustic space, creating multiple reflections and echo decay times. This is one of the most impressive applications of solid state logic to a non-computer product that I've seen. The sound from this system has to be heard to be believed! It's not cheap; suggested list is $595. Some of the exotic hi-fi manufacturers such as Soundcraftsmen have a similar product, but none have the range of control of the Advent.

Energy Technology, Inc., 204 Conway Ave., Las Cruces, NM 88001 announced two energy control systems, the **COBY-1,** a self-contained system for remote control of various appliances and household devices and a second system designed for use with an Apple computer.

Sharp Electronics showed a prototype super-thin-screen television set, in which the regular picture tube was replaced by an electro-luminescence panel only two inches thick. The prototype shown had a B&W 6" (diagonal) screen. A spokesman said the set would *not* be available in the immediate future.

National Computer Conference

Held in Anaheim June 5-8, NCC was the biggest ever with over 56,000 attendance. Except for the overwhelming size, there were few surprises.

Exidy, Inc., one of the large coin-op game manufacturers announced a beautiful personal computer, the **Sorcerer.** It has a full keyboard and numeric keypad (79 keys total) along with the MPU (Z-80), 12K of ROM (containing the monitor and BASIC), and 8K of RAM. It is S-100 compatible which opens up all kinds of expansion possibilities. The Sorcerer uses plug-in ROM PAC cartridges which can contain applications programs, other languages, editors and the like. Another nice feature of the Sorcerer is its very comprehensive graphics and 512 x 240 pixel resolution. Text is displayed in 30 lines of 64 characters each. At the suggested price of $895 it appears that Sorcerer has a lot to offer. (Watch these pages for a complete review).

A number of computer manufacturers as well as independent firms, including *Creative Computing,* announced a line of software, or, more precisely the *intention* to market software. **GRT Corporation** announced a line to be marketed under the brand name G/2 for all major personal computers (TRS-80, PET, SOL, Apple, SWTPC). The dummy packages were beautiful 4-color boxes with space for cassette and instruction booklet inside. Projected price $14.95. *Kilobaud* had more modest 2-color dummy boxes for their cassettes and tiny cassette-size (2½ x 4") instruction booklets which suffered (at least on the samples I examined) from sloppy trimming which cut off part of the printing. Price $7.95.

Peninsula School was showing three tapes for the PET (reviewed elsewhere). **Computer Complements Corp.** announced a line of educational cassettes but had only a partially-completed prototype to demonstrate. PET, Processor Technology, Radio Shack, and Compucolor were all showing personal applications software for their own machines. Naturally many firms were showing small business software although it is most generally available as a system rather than separately. ■

Ramblings Con't....

For more information on any of the following products mentioned above, please circle the appropriate number on the reader service card.

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PeCos I Personal Computer, APF	243
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Anaheim Hosts the Circus ... er ... NCC, 1978

By Mary Borchers

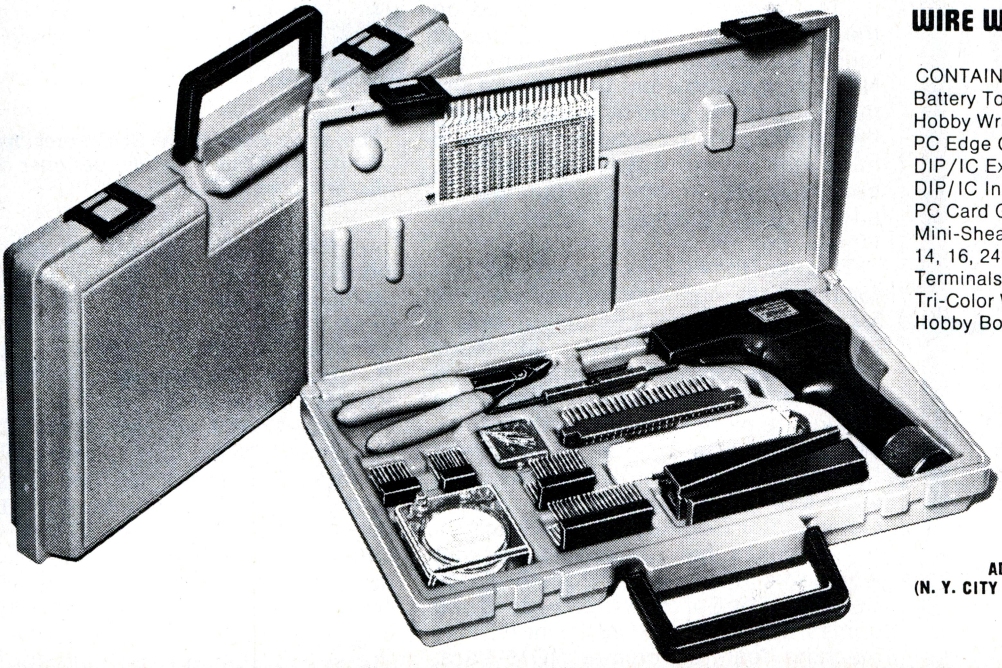
Almost 60,000 people converged on Anaheim between June 5 and 8 to attend the largest (if not the most glamorous) computer conference ever. The 1978 National Computer Conference (NCC) featured a Personal Computer Festival (PCF) as part of the overall conference. Together the well-publicized NCC and PCF managed to attract attendees ranging from the curious newcomer in the computer field to the seasoned electronics enthusiast.

The NCC, centered at the modern and spacious Anaheim Convention Center, was as much an extravaganza as it was a computer conference. This is not to say that the conference sessions were not good. On the contrary, approximately 75 sessions offered something for everyone and featured the most knowledgeable speakers. The conference proceedings were divided into the areas of applications, methodology, systems, and people and society. Session topics included Computer Architecture, Data Base Management Systems, Computer Careers and Education, New Hardware Technology, Software Development Methodology, Performance Measurement, Computer Graphics and Design Automation, and an innovative "Recent Progress in Japan." In addition there was special focus on the world's energy problem.

Registration lines for the conference and exhibit areas sometimes stretched for a quarter mile.

But the NCC exhibit floor was truly a wonder to all who attended. 353 exhibitors occupied 1041 booths in four large exhibit halls at the center, and each exhibitor was anxious to attract his share of attention. During the entire four days the exhibit areas were crowded and there were very few exhibitors complaining about lack of traffic by their booth.

Registration lines for the conference and exhibit areas sometimes stretched for a quarter mile. Once inside there was entertainment at all levels. The huge rooms took on a carnival-like atmosphere, with balloons and buttons, games and contests, puppet



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NCC con't...

shows, pretty young ladies, and the aroma of hot dogs and lots of cold beer. Unfortunately these gimmicks often proved a distraction from the supposed showstoppers — the millions of dollars worth of equipment and services featured at the show.

One could listen to the birds and enjoy the garden-like surroundings at Lear Siegler while inspecting their new CRT terminals and 180 cps matrix and bidirectional printers. ACDC Electronics had a Jack-in-the-Box lookalike mechanical head to draw attention to their power supply products. NCR had a gambling game at which you could win a pocket calculator or antique cash register if you played your cards right. Perkin-Elmer Data Systems' most popular display was a white 1959 Rolls Royce convertible. Many attendees who weren't tired of lines after registration waited to have their photos taken while sitting at the wheel of this Rolls, and then go to Perkin-Elmer's second booth in an adjacent hall to have their photo mounted on a plastic mug.

One of the biggest show-stoppers of the entire NCC was the Racal-Milgo exhibit. Sherry Moreau never failed to attract a crowd when she performed her ten-minute monologue. Her light humor was welcomed by all, even though very few remained after her show to inquire about the modems she was publicizing.

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Once past the glamour and glitter, there was a multitude of new color graphics terminals and 36-inch wide plotters. But the IBM 30 series computer was cause for much discussion since Intel, National Semiconductor, EMM and Memorex all announced their memory systems for the IBM 30, and Intel predicted they will soon have add-on memory for that IBM series also.

Although many of the small computer systems are being readied for the small business, there does not appear to be an abundance of software to meet the needs.

The Personal Computing Festival was located at the Disneyland Hotel, about a quarter mile from the Anaheim Convention Center and spiritually 1000 miles from the rest of NCC. The PCF had its own conference sessions and exhibit area.

Thirteen conference sessions highlighted the three days of personal computing festivities. Topics of discussions ranged from the home and hobby market to "personal" computers in government, education, medicine, and business. There was also a well-attended session on the Legal Aspects of Personal Computing, drawing attention to the question of patents, copyrights, and trade secret protection for software.

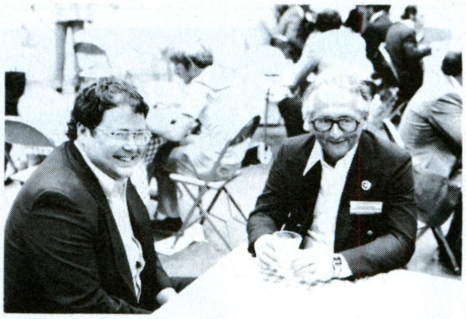
114 companies were represented on the exhibit floor. These exhibits lacked much of the glamour and high cost of the NCC booths, and a less formal attire and manner was assumed by those manning the booths. The crowd did not seem to mind the more casual atmosphere, because what personal computing lacked in size and glamour it made up with innovation.

This year the PCF sponsored a contest for the most ingenious homebrew project. Entered in the competiton was a three-voice synthesizer, an 8080 homebrew computer, a cheap S-100 computer, and computer graphic film making, to name a few of the 22 entries. The winner was Stephen L. Casner of Los Angeles, California, for his solid state Monopoly game. Stephen won a Compucolor Computer for his efforts.

There is a new personal computer which was introduced at PCF, the Exidy Sorcerer. The Sorcerer is Z80-based and comes with 16K of ROM memory. This machine features unique ROM Pacs, which you insert to acquire a high-level programming language, operating system, or special proprietary program. Exidy now has ROM Pacs available for standard BASIC, EPROM, an assembler editor, a disc operating system and a word processing system.

Although many of the small computer systems are being readied for the small business, there does not appear to be an abundance of software to meet the needs. Computertex and DeMarco-Shatz Computer have business application software available. Alpha Microsystems had some business programs running for demonstration purposes, but they don't intend to sell those programs. Osborne & Associates, Inc., offer BASIC business software in book form, and announced conversions of their payroll and cost accounting programs to many systems which are being marketed by other companies. However, Osborne & Associates will not install a system or do any maintenance on programs purchased from them. Radio Shack had a version of payroll running on its TRS-80, but the payroll program was very simple, not even providing employee totals.

Several companies including GRT Corp., *kilobaud* and, of course, *Creative Computing* announced plans for marketing applications software for personal computers. So far it's mostly promises.



The truce table: Mike Scott, president of Apple and Chuck Peddle, designer of the Commodore PET.

A total of 467 companies exhibited products at the NCC and Personal Computing Festival. Still, a few prominent companies were missing from the exhibitor's roster, among them Burroughs Corporation, Hewlett-Packard, Apple and Zentec.

Proceedings from both the NCC and Personal Computing Festival conferences are available. The *Personal Computing Digest* sells for $12.00, 425 pages, softbound. The *AFIPS Conference Proceedings, Volume 47,* sells for $60.00, 1300 pages, hardbound, and contains over 200 papers. To order, or for more information, contact AFIPS Press, 210 Summitt Avenue, Montvale, New Jersey 07645, (201) 391-9810. ■

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PolyMorphic 8813

Steve North

One could easily divide present-day microcomputers into three generations. The first-generation micros have front panels and LED readouts, and often require the user to toggle in bootstrap programs to get running. The second generation of microsystems have permanent Read-Only Memory monitor programs, which permit the user to enter and display memory, load and save programs on cassette or papertape, etc. The third generation, just coming to the fore, free the user from having to know anything about the low-level functions of the computer. They have either BASIC stored in ROM, or built-in floppy disks. The BASIC-in-ROM feature lets the user start running BASIC as soon as the computer is turned on, whereas systems with built-in floppy disks are somewhat more costly but offer much more flexibility, in that the user can have almost instant access to any number of programs including those he has written himself, and in addition, data files. (So much for a terse, one-paragraph analysis of several year's worth of hardware development!)

The PolyMorphic 8813 is an excellent example of this third generation of microcomputers with built-in floppy disks. The 8813 is based on the 8080 microprocessor and the S-100 bus. In other computers, we might question the decision to use the 8080 over the Z-80, the current pop processor, but most users of the 8813 won't really care, which will also be true of all the other third-generation systems. (For the same reason, one could easily argue that the 16-bit processors will not make the anticipated Big Splash.) The PolyMorphic 8813 incorporates up to three minifloppy disk drives, each able to store and retrieve up to 90K bytes of information.

Front-Panel Controls

There are only two controls on the 8813 front panel. One is a key-operated on/off switch with a LED on/off indicator. The switch may be desirable in turnkey applications, but it isn't especially desirable when the 8813 is used as a personal computer system. In my own case, I managed to lose the key while transporting the system from work to home, and until I found the key was left looking at a permanently turned-off computer, wondering how involved it would be to simply short out the on/off switch. In silent mockery, the key bears the inscription, "Do Not Duplicate." The other control on the 8813 is a LOAD button. Just press LOAD and the system restarts itself, by loading and running a program contained on the diskette in drive #1.

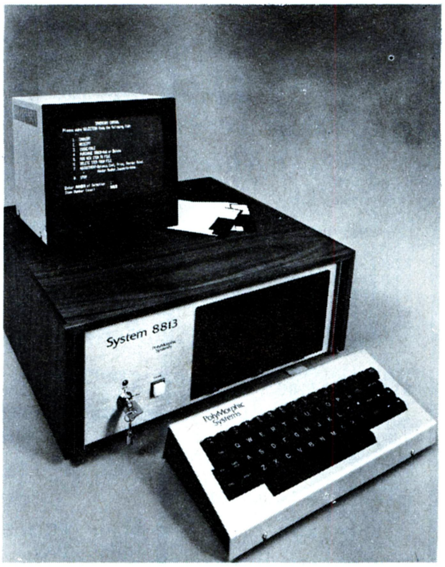
The 8813 also includes a video display board, which can be connected to a standard video monitor to provide very high quality output, and a custom keyboard which is attached to the computer with a ribbon cable. The Poly video board displays 16 lines of 64 characters, including the usual alphanumerics as well as Greek letters, math symbols, and graphics characters.

Another nice feature of the 8813 hardware is that the floppy disk drives shut off automatically if they're not accessed within about 15 seconds. This prevents excessive wear of the diskettes in applications where the computer is left on all day, but on the other hand it doesn't degrade performance when the disk is being accessed frequently (because it does take a little time for the disk to come up to speed before it can be read or written).

Disk Operating System

When the system is booted up (by pressing LOAD or by turning the power on) it can begin running a disk operating system, or some other program that you specify. The DOS (called EXEC) permits you to list the contents of a disk directory, delete files, pack a diskette, run programs stored on a diskette, etc. The packing operation is necessary, because when programs are "deleted" from a diskette, in reality they are only marked in the catalog as being deleted. To recover the space used up by deleted files, one must pack the diskette, which results in juggling the positions of the files on a diskette to eliminate the deleted files. EXEC signs on by printing a title, and then waits for your input. However, you may not always want to use EXEC when the computer is turned on or restarted. If any file on the diskette in drive #1 is named INITIAL *that* file, rather than EXEC, will be loaded and run instead. So if the BASIC language program was renamed INITIAL, the system would sign on with BASIC rather than EXEC, freeing inexperienced users from having to figure out how to get from EXEC to BASIC. (Of course, that isn't very hard either. To run a file, you just have to type its name. So to get to BASIC from EXEC, just type BASIC.) Furthermore, if INITIAL is a BASIC program, the system is smart enough to know that it must load BASIC first, and then your BASIC program. This is a very handy feature, which we haven't seen on any other system.

Disk files stored under EXEC may have names of up to 32 characters and two-letter extensions that identify the file type. For instance, GAME.BS is a BASIC program, LETTER.TX is a text file, MACHINE.GO is a machine-language program, INVENTORY.DT is a data file for BASIC, and so on. If you don't tell the computer which disk drive to look on for a file, drive #1 is assumed. Thus PROGRAM.BS is assumed to be on drive #1. If you want to refer to something stored on drive #2 or #3, you put the number of the drive in before the file name, as in 2 PROGRAM.BS. It is normally not necessary to use the extensions yourself, unless you have several files with the same primary name but different



The minimum PolyMorphic 8813 system consists of one floppy disk (three are shown here) in the main cabinet, a typewriter keyboard, and a video monitor, plus 16K of RAM memory.

extensions. Normally, the computer takes care of the naming of extensions.

The system software is oriented toward doing I/O with the 8813's own keyboard and video display. In other words, you can't hook up another terminal and use that instead. But there's no need to, since the video display provides a very readable and flexible means of displaying output. For hard copy, the 8813 has a printer port for any RS-232 device, and a printer driver and configuration routine that permits you to set up all the parameters for your printer in software, instead of by changing switch settings or jumper wires in the hardware. Unfortunately, the 8813 software is not designed to let you say, "Print out everything that's displayed on the screen." Instead you have to use separate commands to specify that something will be sent to the printer. Granted, the video display has many special characters that most printers do not, and in some applications it may be desirable to use the screen for one thing and the printer for something different, but it would be nice to give the user the option to do either. While on the subject of I/O, we'd like to point out another nice feature of the 8813's buffered-ahead input. This means that while the system is busy with some operation, you can type commands for it to execute when it's ready. A light-bulb inside the LOAD button indicates when the system is accepting the buffered-ahead input.

Text Editor

Included in the 8813 system software is a very nifty screen-oriented text editor. The editor operates upon a disk file but the editing is actually done on a buffer in memory. The screen is used as a window on any 16 lines in the text buffer. Text may be added, inserted, deleted, moved as a block, searched for some string of characters, and so on, by using a cursor that may be positioned anywhere in the text buffer. This editor isn't the ultimate, but I would certainly prefer a screen-oriented editor to a text editor that must work around the constraints of a normal terminal and which must use line numbers or some kind of non-visual text pointer. The text editor may be used to create or modify BASIC program files. To use the editor, just type EDIT FILENAME when in EXEC. Sure beats typewriting if you can justify the cost.

In case you are interested in machine-language programming, the 8813 EXEC software has a simulated front-panel mode, in which the screen displays the registers, memory, etc. This helps you debug your assembly-language programs. The 8813 system software includes a disk assembler.

Disk BASIC

PolyMorphic's Disk BASIC seems like a good BASIC. It has most of the features people expect in an Extended BASIC: a full set of functions (SIN, COS, TAN, ATAN, ASIN, INT, SGN, RND...), character strings, arrays, multiple statements, etc. It also has some nice features you may not have seen before: DUMP to print out the values of all the variables used in a program, data file handling, a MAT statement (which works as an implied FOR loop on a matrix), and PLOT for use with the Poly video display. PLOT is really a lot of fun. The video screen represents the first quadrant, and using PLOT you plot X and Y values. The plot extends from 0 to 127 along the x-axis and from 0 to 47 along the y-axis. With suitable offsets and scaling factors, you can plot whatever you want. With only a couple hour's experimentation, I was able to plot parabolas, sinewaves, and even functions in polar coordinates. Of course, it doesn't have the resolution of a real plotter, but it's within the financial reach of many more personal and educational computer users.

We only have two complaints about PolyMorphic's Disk BASIC. First of all, it is necessary to use an EXIT statement to leave a FOR loop prematurely. If EXIT is not used, BASIC assumes that all FOR loops are active unless they have been terminated normally. When EXIT is used, BASIC forgets all active FOR loops. In other words, there is no easy way to leave an inner FOR loop prematurely, and to keep using an outer FOR loop. A lot depends on the internal structure of BASIC, but offhand it would seem to me that it's much better to have BASIC itself determine when a loop is active or not. One can simply decide that (1) all normally terminated loops are inactive, and (2) all active loops begun after a loop that has been terminated or re-started are inactive. EXIT is non-standard (you won't find it in any BASIC books) and it seems like a kluge. The other problem is that BASIC can't detect the end of a data file, but this can be remedied by merely using a dummy data-item to detect an end of file.

Another good feature is the WALK command, which lets you single-step a a BASIC program to see what's happening. This is like a TRACE, but with a little more flexibility. Overall, Poly's Disk BASIC is good.

Error Messages

One of the things that impressed me most about the 8813 was the completeness of system error messages. Generally, a complete description, not a numeric code, is displayed. For instance, BASIC will point to a location in a statement and

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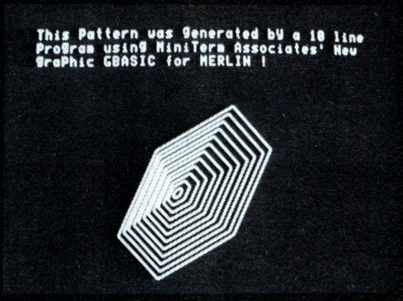

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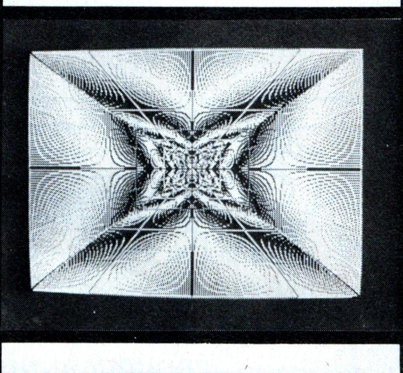

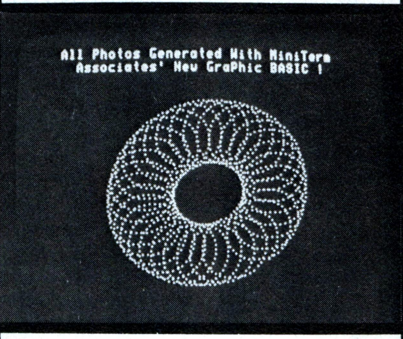

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say "Bad Subscript" or EXEC will say "I can't do that to a system file!", instead of telling the user BS ERROR or ERROR 0232. And, after all, why should people have to learn codes and abbreviations for errors? The 8813 software uses disk overlays so that the functions of the system are not directly limited by the amount of memory in the computer. Since floppies are not as fast as hard disks, the overlays must be planned carefully, so that response time is not degraded to a serious extent. But with the overlays, it is possible to keep BASIC's error messages out on disk, and only call them in when needed.

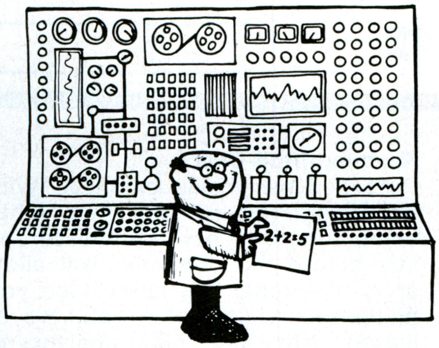
The 8813 manual is well-written and contains enough explanation for a beginner in using the computer. For example, the manual explains what a floppy disk is, and tells the user that he doesn't want to remove it from its sheath. OK, if you've used diskettes before, that may seem a little stupid, but it isn't immediately apparent to a first-time user that you don't want to take the disk out of its little envelope. Likewise, the manual includes an introduction to BASIC, and a regular full-scale manual.

One of the diskettes that came with our 8813, borrowed for review, had some interesting application programs, for business analysis, planning of a personal budget, etc. These programs aren't available from PolyMorphic—they feel that the computer stores can do a better job of helping customers with applications programs—but they did demonstrate to me that the 8813 is quite suitable for running these kind of applications.

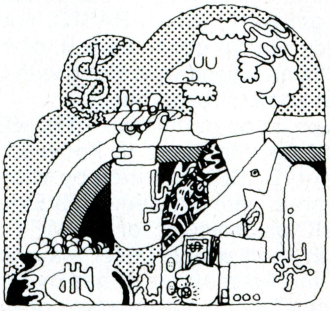
The 8813 can be used with as little as 16K of memory, but of course more may be required, depending upon your application.

Who should buy the 8813? I don't think it's a machine for hobbyists. For amateur computing, a Z-80 system with full-sized IBM 3740 compatible disk drives and an interface to a standard RS-232 terminal would be more useful. On the other hand, the 8813 might be an ideal choice for the professional who has some serious use in mind for his computer and doesn't really want to hack around with computers themselves, or for education. The 8813 has so many well-planned details that we can't remember them all. Although the 8813 is priced at the high end of the microcomputer market, it offers an integrated and people-oriented package of hardware and software, found in few other systems. ■

What's Your Small Business Computing IQ?



1. Five microcomputer-based inventory management systems were available as of Feb. 1978. Each costs less than _______ complete.
   - A. $1000 C. $10,000
   - B. $4000 D. $30,000
2. Which of the following is the most effective word-processing system?
   - A. Vydec
   - B. Electric Pencil
   - C. IBM Mag card Selectric
   - D. All of the above depending upon application
3. An 8" floppy disc will store a mailing list approximately how large?
   - A. 300 names C. 3000 names
   - B. 1000 names D. 10,000 names
4. Computer conferencing is most useful:
   - A. In a single building
   - B. Between offices in one state
   - C. Between offices in several states
5. What kind of investment analysis is suitable for a microcomputer?
   - A. Analysis of puts and calls
   - B. Arbitrage of options
   - C. P/E and yield trends
   - D. All of the above
6. A microcomputer-based fire /smoke /intrusion detection system can be easily cost justified.
   - A. True B. False
7. Six magazines deal with small business computing. Which is most comprehensive?
   - A. Mini/Micro Systems
   - B. Interface Age
   - C. Small Business Computing
   - D. Creative Computing
   - E. Small Systems World
   - F. Kilobaud
8. The lowest cost ($600) microcomputer systems are best suited for which application(s)?
   - A. Environmental control
   - B. Maintaining customer files
   - C. Computer Assisted Instruction (CAI)
   - D. Accounts receivable processing.
9. Most business applications can be done using audio-cassette tapes for record storage.
   - A. True B. False
10. Which of the following is *not* a commonly available microcomputer language?
    - A. BASIC C. FORTRAN
    - B. Assembly language D. COBOL



Answers

1. B. A basic microcomputer costs $1000 or less, but with printer, floppy disc and software to do inventory control, the cost is about $4000. All five systems were extensively described in the Mar /Apr '78 issue of *Creative Computing*.
2. D. But you may not know that the microcomputer-based Electric Pencil system costs one-third of the others. *Creative Computing's* extensive new product section keeps you up to date on all the new small business computers.
3. C. Assuming about 100 characters in the name and address, 3000 names can be stored with current packing densities. A 5" mini-floppy will store about one-quarter as much.
4. C. With computer conferencing, a central computer stores the remarks of each participant and each person can hook up with or leave the conference system whenever it is convenient. Thus a Delaware office can hook in at 6 am, the Illinois plant at noon, and an Oregon manager at 9 pm with no inconvenience to each other.
5. D. Using a microcomputer allows you to analyze more data faster than you could ever do by hand calculator. In fact, brokers at several large brokerage houses are now using microcomputers to analyze their customers' accounts.
6. B. Self-contained systems for fire /smoke /intrusion detection cost less than one third of a microcomputer-based system. However, the micro can also do many other tasks and *may* be cost justified as a result. These systems are extensively described in the Jul /Aug '78 *Creative Computing*.
7. D. Obviously we're biased and you'll have to make up your own mind. But if you want system evaluations, new product news, programming techniques along with a nice balance of applications in other areas — a full 120 pages of *editorial* content every issue — then you'll want to try *Creative Computing*. Three years for only $21 — the same as 3 bottles of Scotch.
8. C. A $600 microcomputer is certainly capable with its keyboard, CRT screen and microprocessor but it doesn't have a printer, mass storage, sensors, control lines or other peripherals needed for most business applications. A system for business applications will generally cost $3000 plus
9. B. Audio cassettes are too slow and do not permit random access to data in a file. Nearly all business applications use a floppy disk unit for storage of permanent data.
10. D. As of early 1978, COBOL was not widely available for any microcomputer. However, several firms were said to be working on versions of COBOL for introduction at some future time. BASIC and FORTRAN are generally used for business applications on microcomputers.

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A Creative Computing Software Profile...

Radio Shack TRS-80 Level II Basic

Stephen B. Gray

Perhaps you have a Radio Shack TRS-80 with Level-I BASIC and you're wondering whether to move up to Level-II. Or you're thinking of getting a TRS-80, but aren't sure which model to get. And although the difference in price between the two levels is only $99, maybe the money isn't all that easy to come by. So let's take a look at what you get with Level-II BASIC. You may decide you've got to have it, or maybe you'll find you can get along with Level-I and some subroutines.

Even if you don't have a TRS-80, you might be interested to know that the Level-II BASIC is written by Microsoft, and practically the same 12K Extended BASIC as provided for the MITS Altair 8800b, and which Imsai may also be offering for their machines by the time you read this. So if you have, or will get, an 8K Altair or Imsai, you might want to know what you can move up to with 12K Extended BASIC. Incidentally, Exidy's new Sorcerer computer, described elsewhere in this issue, uses Microsoft 8K BASIC.

One command found in Altair 8800b Extended BASIC, but not in TRS-80 Level-II BASIC, is RENUM, which automatically renumbers all your program lines. The reason is that the Altair Extended BASIC takes up 14.6K in RAM, and some things had to be left out of the 12K TRS-80 version. However, RENUM is such useful command that Radio Shack has decided to offer RENUM on tape shortly. Incidentally, Radio Shack is currently considering FORTRAN seriously. COBOL is, they say, "too expensive in memory." But DOS is "great."

BASIC in ROM

If and when you decide to move up to Level-II, you take your Level-I keyboard unit and $99 to the nearest Radio Shack. The store sends it off to a Service Center where the 4K Level-I ROM is removed, and the 12K-Level-II ROM is inserted (three 4K ROMS, actually). With BASIC in ROM, you have the maximum amount of RAM memory at your disposal. For instance, if you stay with Level-I, and write all eleven of the math subroutines provided in the Level-I manual into your RAM memory, you'll have less than 700 bytes of RAM left for your main program. Which is why the manual advises that you "try saving different combinations of subroutines on cassettes: for example, make a SGN/COS/TAN cassette, a SGN/SQR cassette, an EXPONENTIAL/LOG EXPOENTIAL/SGN cassette — whatever combinations are useful to you." So if you need most or all of those subroutines, but don't want to move up to Level-II, and if you'll be writing programs of substantial length (such as any complex game, or almost any business program), you may have to convert your 4K computer to 16K, which will cost you $290. And even if you save on RAM by going to LEVEL-II, which has dozens of subroutines stored in the 12K ROM, you'll still need 16K of RAM if you'll be doing any extensive programming. If you need more than 16K of RAM, you'll have to get the $299 Expansion Interface, which can accommodate one or two 16K RAM units, to give you a total of 32K or 48K RAM. If that sounds like a lot of RAM, note that the TRS-80 Business System, as configured by Radio Shack, includes 32K of RAM.

Not all the additional features provided by Level-II are as obviously important as print formatting or string manipulation. Two examples are keyboard roll-over and faster cassette-data transfer rate, which make for faster programming and computer operation.

Keyboard Roll-Over

As the Level-II manual puts it, "With the Level-I TRS-80 (and many other computers) you have to release one key before the computer will allow entry of another key. Level-II lets you hit the second key before you have released the first key. This is great for you touch-typists." There's a limit, however, and if you're such a sloppy typist that you hold down three or four keys at a time, some keys will then generate several characters when you press just that key.

Faster Transfer Rate

When you load Level-I programs from the cassette recorder, or record programs on it, the transfer rate is 250 baud, meaning 250 bits per second. The Level-II transfer rate is twice that, or 500 baud. This doesn't doesn't mean the cassette recorder runs twice as fast for Level-II, but that the Level-II bit-packing is twice as dense as on Level-I tapes. That is, twice as much information is stored on an inch of Level-II tape as on a Level-I tape.

Because of this faster transfer rate, Level-II 500-baud tapes must be read with the cassette recorder's volume control set at 5 or 6; Level-I 250-baud tapes are read with a volume-control setting of 8 or 9.

Editing Features

Many owners of a Level-II TRS-80 may never use its editing features. If the programs you use are mostly "canned" programs (bought from Radio Shack or elsewhere), or if you write programs with short lines, or if you're such a good programmer that you seldom if ever need to correct or change a line, you may never need to do any editing.

Also, if you seldom need to edit, you might not want to bother with the Level-II editing capabilities, simply because they're so extensive that if you don't use them much, you may have to refer to the manual every time you want to edit.

But if you edit frequently, you'll find that because program lines can be changed so easily, "you'll probably be able to do much more experimenting with multi-statement lines, complex expressions, etc.," as the manual puts it.

No point going into editing in depth here, but here are some of the things you can do. You can list any line individually, insert material anywhere in a line, delete the rest of a line beyond the cursor and insert material in its place, delete any desired number of characters to the right of the cursor, change a specified number of characters, search (for example) for the third occurrence of letter L and move the cursor to that position, and tell the computer to delete (for instance) all characters up to the third occurrence of letter L, and move the cursor to that position.

Other editing features permit you to end editing and save all changes made, or to end editing and cancel all changes made in the editing session, or to cancel editing changes already made and restart.

16-Digit Accuracy

Eight digits are enough for many applications, but if you need more for scientific, accounting or statistical use, you can specify that a variable be single or double precision. Ordinarily, asking the computer to calculate the value of 1/3, will give you a 6-place decimal. But if you ask it to PRINT 1/3#, you'll get a 16-place decimal. An exclamation mark will keep a variable at single precision, as in A! or Z1! If you're working with whole numbers, declaring them as integers (with a percent sign as in A%) will take up half the space in memory, and execute twice as fast.

Formatted Print

PRINT USING, as the manual says, "allows you to specify a format for printing string and numeric values. It can be used in many applications such as printing report headings, accounting reports, checks...or wherever a specific print format is required." Using nine "field specifiers," you can specify digit positions, cause automatic rounding-off, create a "floating" dollar sign that will position itself in the first position preceding a number, join together (concatenate) multiple strings or string variables or (for example) print only the first letter of a group of strings, align columns, etc.

Strings

"Without string-handling capabilities, a computer is just a superpowered calculator," the Level-II manual says. Many applications are difficult or impossible without string-manipulation functions, which are required in many of the games in our *Basic Computer Games* book, for example. We get frequent telephone calls from people who insist, for instance, that the BANNER program on page 10 (of the Microcomputer Edition) has bugs in it, because it won't run on their computer. Then we find that their computer can't handle this line

```
80 P$=MID$(A$,T,1)
```

or the lines that involve LEFT$ or LEN.

"Level-I BASIC offers two string variables [A$ and B$]," to quote again from the Level-II manual, "which can be input and output to make your programs look "friendly" (as in HELLO, BOB!). In Level-II...any valid variable name can be used to contain string values, by the DEFSTR statement or by adding a type declaration character, $, to the name. And each string can contain up to 255 characters. Moreover, you can compare strings in Level-II, to alphabetize them, for example. You can take strings apart and string them together (concatenate them)." Level-II offers around 900 variable names.

Strings can be compared by using the same relation symbols for comparing numbers, such as equal-to, greater-than, etc. Actually, the ASCII codes for the characters are compared, so A! will precede A#, for example.

ASC and CHR$ are handy for a variety of uses, including coding and decoding to make secret messages. ASC gives you the ASCII numerical code for a string character, and CHR$ does the reverse.

INKEY$ lets you input keyboard values while the computer is executing, without using the ENTER key, very important in many video games. INKEY$ strobes the keyboard and returns a one-character string, which will be a null string if no key is pressed during the strobe.

Several functions permit manipulating characters or groups of characters in strings. LEFT$, along with the name of a string and a number, will select as many of the characters from the left end of that string as the number calls for. If A$ is TIMOTHY, then

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LEFT$(A$,3) will select TIM, and if this is assigned to B$, then PRINT B$ will print out TIM. MID$ will select characters from the middle of a string, and RIGHT$ from the right end. LEN gives you the character length of the specified string. STRING$ provides a string composed of as many characters as you specify, so that STRING$ (30, "*") can be used to print a row of 30 asterisks, very handy in creating graphs, tables, etc.

Simplified Debugging

Type in TRON at the end of a Level-II program, RUN the program, and the screen will show you the exact sequence of program lines followed in executing the program. To turn off the Trace function, enter TROFF.

TRON and TROFF may be used inside programs to show when a certain line is executed. For example.

```
50 TRON
60 X=X*3.14159
70 TROFF
```

will point out every time line 60 is executed. Each time these three lines are executed, 60 70 will be displayed. Without TRON, you wouldn't know whether the program was actually executing line 60.

More Arithmetic Functions

Level-I BASIC offers four built-in functions: MEM (tells you how many unused bytes are left in RAM memory), INT (integer), ABS (absolute value) and RND (random number). Level-II BASIC offers these four, and a dozen more. The trig functions are SIN, COS, TAN and ATN. More math functions are provided by EXP, LOG, SGN and SQR. Using RANDOM at the beginning of a program ensures that you get a different sequence of random numbers each time you run a TRS-80 program involving RND. CDBL provides a double-precision value of the expression following CDBL in parentheses, even if the operands are single-precision or integers; CSNG does the opposite by providing a single-precision value of the expression. This may be automatic CSNG for disk only!?

Many other functions may be created using the 16 Level-II functions, and Appendix F provides a pageful, such as inverse sine and hyperbolic secant.

Cassette Verification

By entering CLOAD? and a file name, you can have the computer compare a program stored on cassette with one presently in the computer. This way you can be sure the program was written correctly on the tape during a CSAVE.

Specific Error Messages

Level-I BASIC has three error messages, WHAT? (the computer doesn't understand the line), HOW? (the computer understands, but can't comply), and SORRY (memory is full).

Level-II BASIC has 23 two-letter error codes, that are much more specific including NF (NEXT without FOR), LS (string too long), and MO (missing operand).

Arrays

Arrays are permitted in Level-II BASIC, and with many dimensions as available memory will permit. String arrays are permitted.

Fewer Abbreviations

One advantage of Level-I is that 27 of the statements and commands can be abbreviated, such as P. for PRINT and N. for NEXT. None of these are allowed in Level-II. A conversion tape is provided with every Level-II TRS-80, and with every Level-II upgrade. The tape's main function is to convert P. to print, N. to NEXT, etc.

Faster Graphics

To fill the graphics portion of a video-monitor screen in Level-I BASIC, using an array of rectangular "graphic blocks" 128 across and 48 down, and by using SET and FOR-NEXT statements, takes about 49 seconds. But Level-II has POKE, which loads a value into a specified memory location, and Level-II also has 63 special graphics characters. These 63 are all the possible combinations of six "graphic blocks" in a 2-by-3 matrix.

Although "graphic blocks" can be printed as many as 128 across and 48 down, letters and numbers can only be printed in 16 lines of 64 characters each, for a total of 1024 PRINT locations. Each of the 1024 locations takes up a space two graphics blocks across and three down. By using POKE and the last of the 63 graphics codes, which is 191, for "all 6 bits on," the screen can be "painted white" much faster, theoretically six times faster than using SET. When I tried it, the screen was filled in less than 7 seconds, quite a bit less than the 49 seconds taken by SET statements.

This can be speeded up even more by using integer variables: using SET, the screen is filled in 35 seconds; with POKE, only five seconds!

The partner of POKE is PEEK, which tells you what's stored in a specific byte address in RAM memory. POKE and PEEK can be used "to set up very compact, byte-oriented storage systems," and require a good knowledge of memory maps and tables of codes.

Machine-Language Subroutines

The USR statement permits calling a machine-language subroutine, which is handy for quick table lookup, for much faster graphics than possible with POKE, etc.

Double-Width Characters

Mentioned twice in the Level-II manual, but never commented on, is the fact that if you hit the shift key and the right arrow, the screen display will convert to a 32-character-per-line format, and hitting the clear key will return the display to the regular 64-character-per line format. In other words, SHIFT provides characters twice as wide (but not twice as high) as the regular ones. These can be seen from much further away, and are handy for scoreboard displays, and for any classroom work.

Note that anything on the screen at the time of conversion will have only every other letter enlarged, so that RADIO SHACK LEVEL-II BASIC becomes (twice as wide) AI HC EE-IBSC, which can be quite mysterious if you don't know what's going on.

Search for File A

Level-II BASIC lets you specify a desired file in your CLOAD command. So if you write CLOAD "A", the computer will ignore all programs on the cassette until it comes to the one labelled "A". As the computer searches for file "A", the names of the files encountered along the way will appear in the upper right of the display, along with a blinking*.

Level-II Manual

The 121-page Level-II BASIC Reference Manual is meant to be read after you've already had "considerable experience with programming in BASIC," as the foreward says, continuing, "Our Level-I User's manual was written for the total beginner.... We freely admit this Manual has not been written from the same perspective."

As a reference manual, the Level-II book doesn't go into the detail that the 233-page Level-I User's Manual does. (The Level-I manual does such a good job of teaching the elements of BASIC that Radio Shack offers it separately, at $5.95.) The Level-II manual presents nine subroutines for array/matrix manipulation, for example, with little or no explanation of what each does. One of the eight appendixes lists the 31 function codes, but doesn't tell how to use them in a program; you'll have to figure this out for yourself.

The last appendix is User Programs: a space-ship lander game; Customer Information, for building a name/address/phone number file; Triangle Computation with Graphics; a target-practice game; and Ready-Aim-Fire, a new version of the Level-I bouncing-dot game. ■

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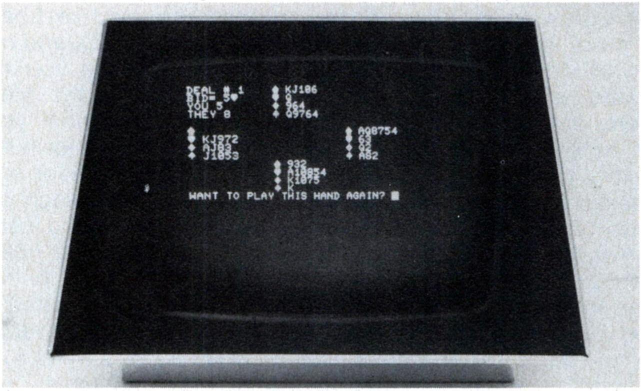

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Merlin Video Interface

by Jim Baker

Introduction

Currently there are many video interfaces available for S100 Bus computer systems. Indeed, this number seems to grow monthly. Furthermore, no two of these interfaces are the same. They vary widely in both cost and capability. This article describes one such video interface, the Merlin by MiniTerm. The article does not attempt to compare Merlin to other video interfaces and tends to have a positive bias, as I like my Merlin.

My background is programming, not electronics. However, my electronics knowledge is growing as I build and fix more and more kits. Much of my experience with video interfaces come from working with computer terminals, where the video interface is integrated. At work, I have access to a Tektronix 4014 graphic terminal which has a fantastic resolution of 4096 by 3120 points, about the best on the market. However, the 4014's price of around $12,000 is too expensive for me. This led me to search for an inexpensive video interface with graphic resolution of 100 by 100 points or better. In addition, since I planned to get a system without a front panel, I also wanted a monitor board. As you will see, Merlin satisfied those needs and more for me.

Merlin Overview

When I first heard the name Merlin, I asked myself "What is it?". If the question were "Who?", the picture on their manual of a wizard, presumably from King Arthur's court, would have solved the problem. But, the question was "What?", and I had some research to do. As I acquired information one thing became very clear, Merlin is more than *just* a video interface.

The basic Merlin unit consists of two high quality printed circuit boards with the following capabilities: a video interface, with upper case character generation, 40 characters on 20 lines, as well as 160 by 100 point graphic resolution; a parallel input port for keyboard interfacing; a serial I/O port for the cassette option and last, but very important to me, the provision to add two ROMs.

But that's just the basic unit! You can then add any of the following options: lower case character generation; a cassette interface (MCAS — Merlin CASsette) which uses the serial I/O port on the basic unit and buffers the parallel input port; Super Dense, increasing the graphic resolution from 160 by 100 points to 320 by 200; and two software monitor ROMs, the MBI (Merlin Basic Intelligence), and the MEI (Merlin Extended Intelligence). The ROMs provide software to simulate a front panel, output data to the screen, read keyboard input, perform cassette I/O, and more.

As you can see, you might be better off calling this the Merlin I/O subsystem. But, by now, you're probably thinking, "That's nice but what did it all cost?". Well, in kit form, the basic unit costs $269, with each option costing $39. While you could just buy the basic unit, I feel two of the options are worth having: MCAS and the MBI ROM.

I became interested in not only where Merlin is today, but where MiniTerm plans to take it. In talking to MiniTerm and reviewing the current sales brochures, I expect the following options and expansions: color graphics; greater character and graphic display densities; game controllers, consisting of four switches which plug into the cassette interface (notice the continued use of what's already there, tending to protect the initial investment); and, joysticks. I somehow feel that they're keeping themselves busy at MiniTerm.

But "who?", or "what?" is MiniTerm. As it turns out, MiniTerm was started by two hobbyists who were unhappy with the state of the art in video interfaces and decided to change it. In October of 1976, they went into the Merlin business full time. The original Merlin unit was announced in September of 1976 and deliveries began in January of 1977. As with most firms, they got caught with unexpected startup delays. However, MiniTerm thought far beyond those first units and soon the add-on options, utilizing features on the basic unit, began to appear. MiniTerm now sells complete systems, although everyone seems to do that.

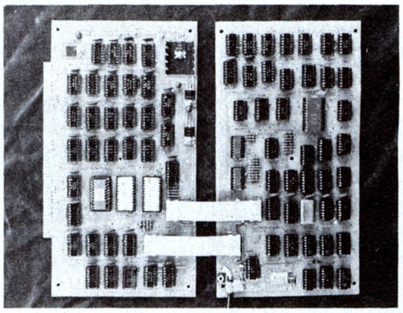


Figure 1

The Hardware

The two Merlin circuit boards are solder masked, but not silkscreened. However, with the comprehensive assembly instructions, I found no great need for silkscreening. The boards mount piggyback fashion (see figure 1) and connect with two 14 line ribbon cables. Even though only one of the boards actually connects to the S100 bus, two positions are taken up.

The parts, for the kit versions, come in several bags. Each bag contains a list of the contents, with a number that indicates the board to which the parts belong. The super dense option comes on a separate circuit board which attaches to the main unit using two wire wrap sockets. Super dense mode (see figure 2) replaces sparse mode. Super dense mode has a resolution of 320 by 200 points. You add lower case character generation by placing a lower case ROM on top of the existing upper case ROM. The cassette option, including keyboard buffers, is on a

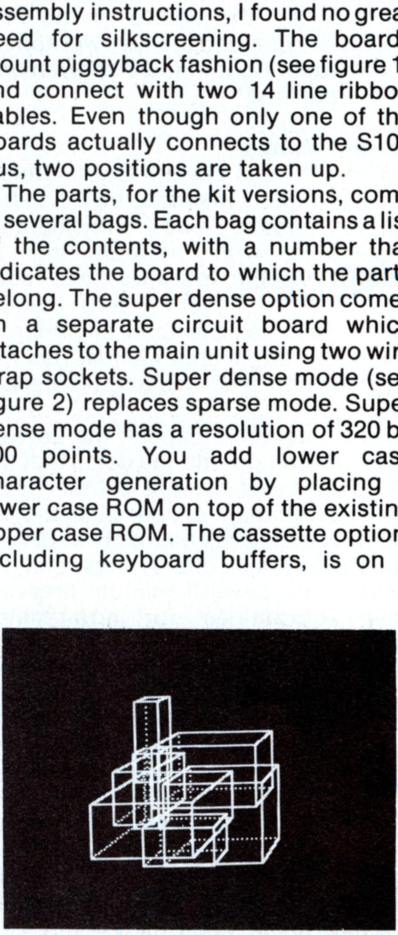


Figure 2

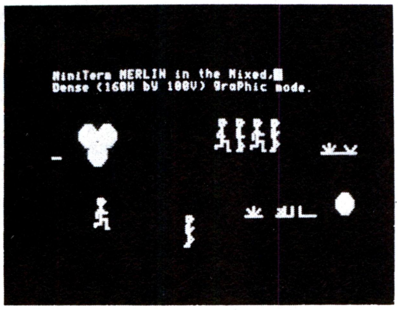
Jim Baker, Apt. 2K, 405 Lindsley Drive, Morristown, NJ 07960.

Merlin Con't. . .

separate circuit board, which MiniTerm recommend you mount in your keyboard case. The two software ROMs plug directly into the basic unit. The MBI ROM comes with a 256 byte scratchpad RAM. Both ROMs use this RAM for stacks, display parameters, etc. If you wish to get the MEI ROM, you must have the MBI ROM. If you don't want to use MiniTerms monitor, you can put in your own using 2716's, 2708's, or 2704's. Merlin, along with the optional ROMs, occupies an 8K memory range starting at hexadecimal C000.

Hardware Operation

Merlin displays data on the screen in one of four modes: two character and two graphics. The two character modes are fixed and free form. In fixed mode, Merlin displays a total of 800 characters, 40 characters on 20 lines. In free mode, the number of characters displayed varies. Here, Merlin displays data on a given line until a carriage return is found. The carriage return causes Merlin to blank the rest of that line and start displaying data on the next line. Thus, free mode allows "lines" longer than 40 characters to be stored in memory. Also, free mode generally uses less memory than fixed mode, as you do not have to pad lines with blanks. The two graphic modes are sparse and dense. These modes define the graphic resolution which Merlin will use, 80 by 100 points for sparse mode or 160 by 100 points for dense mode. Mixed mode is a combination of the character and graphic modes already discussed. In Mixed mode, Merlin displays characters in the top part of the screen and graphics in the bottom (see figure 3) the display changes to graphic mode when an HEX "00" is found. This means that the size of the two areas is under software control. There is also a game mode, but I haven't gotten to it yet. There are so many modes! In addition, there are more combinations possible when the other display parameters are used, but that could be an article in itself.The manual devotes over ten pages to the topic of display parameters.



```
MiniTerm MERLIN in the Mixed,█
Dense (160H by 100V) Graphic mode.
```

Figure 3

Merlin uses DMA to get display data from memory. This means that the CPU can tell Merlin to start displaying data from anywhere in memory. However, DMA does have the disadvantage of making the CPU wait while Merlin gets the data. As a result, Merlin slows the CPU down from a low of 8 percent in free mode, to a high of 53 percent in super dense graphic mode. Turning the display off also turns DMA off. With DMA off, the CPU runs at full speed. This is very useful when you have a large number of calculations to perform without needing the display until the results are ready. Furthermore, being able to turn DMA off is a must when a Tarbell disk controller is used. Finally, DMA overhead from Merlin is a constant percentage. So, in my case, even in super dense mode, the CPU runs at 1.82MHz (47 percent of 4MHz). This is faster than some systems run with no DMA!

You access both the keyboard and cassette using memory mapped I/O, thus *any* memory reference instruction can access them. The cassette interface is software driven, meaning that the CPU must provide data to the interface at the proper speed. Although this means that your CPU cannot perform any other functions while reading or writing a cassette, it also means that you can read or write cassette tapes in any format. Furthermore, the software sets the speed at which tapes are read or written! MiniTerm provides a listing of the software to read and write Tarbell™ formatted tapes, or you can get the MEI ROM which contains it.

The Software

About the only thing I would debate about the MBI ROM software is the use of the word "basic." The MBI is the central software workhorse of the Merlin unit. This software makes interfacing BASICs and other monitors a snap. After powering up my computer, I hit reset, the CPU board jumps to the monitor, and away I go!

Before I discuss the good features, there is one bad thing I found in the MBI monitor: all commands *must* be in upper case. Furthermore, any data you give to the command must also be in upper case. This means you must either use only an upper case keyboard or place a software routine in front of the keyboard software to correct the problem.

I group the monitor commands into three categories: "front panel" commands, utility commands, and screen control commands. The front panel commands allow you to display and/or modify memory or the CPU registers, or execute a user program with breakpoints. The utility commands allow you to fill any area of memory with a given HEX value, copy one area of memory to another, or input character data.

The screen control commands allow you to move the cursor, or modify the display parameters (e.g. set modes, etc.). Merlin's cursor defines the location where data will next appear on the screen, including data you input. Commands are available to move the cursor up, down, left, right, to one of two user defined locations, or even to another screen by "paging" backwards or forwards. You can also request Merlin to insert, replace, or delete characters, or delete lines. These commands provide the software needed to create an extremely powerful editor!

You control the display by defining where, in memory, it will start and end, and what display mode Merlin will use for that area. You can define up to two areas at once and request "flipping" back and forth between them. This "flipping" is very useful when you want to work with graphics in one area of memory and character data in another.

Finally, it is worth noting that you can call all of the commands from any program you write, and most of the commands will accept parameters from your program (see BASIC example below). In addition, utility routines are available for many useful tasks such as reading HEX or character data from the keyboard, writing the contents of the accumulator or HL registers to the screen in HEX, or displaying a message on the screen.

As if that weren't enough, there's also the MEI ROM software. The MEI commands and subroutines build upon the MBI base. The screen control commands are extended to allow operation in the graphics modes (e.g. draw a line, move graphics cursor, etc.). The editor commands are extended to provide string locate and/or change, block delete, word delete, block copy, and word skip. Finally they added the tape read and write commands, block verify, Hex locate, and Z80 register display and modify.

The following is a BASIC program which draws perspective "boxes" (see figure 4). It is meant to serve as an

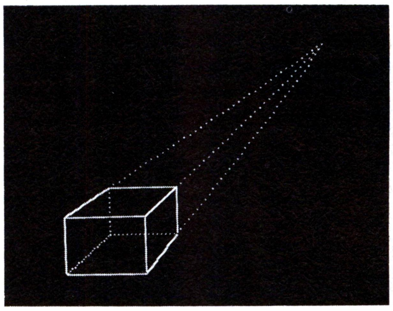


Figure 4

example of how you can use Merlin's graphics capabilities from BASIC, and not as a functional program. You would have to add some assembler routines for the program to be complete.

BASIC EXAMPLE

```
1000 REM INIT ASM SUB S1 - ADD X1,Y1, X2,Y2 TO TABLE
1010 S1=24001
1020 SO=S1
1030 GOSUB 2420
1040 DATA &E1,&2A,&60,&D0,&D1,&73,&23,&72
1050 DATA &23,&D1,&73,&23,&72,&23,&22,&60
1060 DATA &D0,&C9,300
1070 REM/  S2  CALL PATTERN
1075 S2=SO
1080 GOSUB 2420
1090 DATA &E1,&E1,&C3,&C2,&BD,&300
1100 REM/  S3  EDIQ
1105 S3=SO
1110 GOSUB 2420
1120 DATA &E1,&C3,&B3,&C3,300
1130 REM/  EDIQ VARIABLES
1135 SO=&D034
1140 GOSUB 2420
1150 DATA &81,&3E,&81,&3E,&81,&3E,&C0,&5D,&11,300
1500 Z=1
1510 Z=RND(-1)
2000 REM
2010 REM/ INIT GRAPHIC VARIABLES
2020 POKE &D07B,&3E
2030 POKE &D07A,&81
2100 GOTO 3000
2200 REM/ SUBROUTINES
2210 REM/ DRAW PATN SUB
2220 POKE &D079,1 :REM/ SET TO OR
2230 POKE &D06A,0
2240 POKE &D06B,0
2250 POKE &D06C,0
2260 POKE &D06D,0 :REM/ X=Y=0
2270 CALL S2,PO
2280 RETURN
2300 REM
2310 REM/ CLEAR SUB
2320 POKE &D079,2 :REM/ CLEAR (CPL, AND)
2330 GOTO 2230
2400 REM
2410 REM/ POKE SUB
2420 READ A
2430 IF A>255 THEN RETURN
2440 POKE SO,A
2450 SO=SO+1
2460 GOTO 2420
2500 REM
2510 REM/ LOAD POINTER
2520 P1=INT(PO/256)
2530 POKE &D061,P1
2540 P1=PO-256*P1
2550 POKE &D060,P1
2560 RETURN
2900 REM
2910 REM/ DELAY
2920 RETURN
3000 REM
3002 REM/ MAIN LOOP
3004 CALL S3  :REM/  EDIQ (FLIP SCREEN)
3020 I=1
3030 PO=&3DB9
3035 GOSUB 2520
3040 GOSUB 4020   :REM/ CALC PATTERN
3050 GOSUB 2220   :REM/ DRAW PATTERN
3060 PO=PO+I*90
3065 GOSUB 2520
3070 GOSUB 4020   :REM/ CALC NEXT PATTERN
3080 GOSUB 2920   :REM/ DELAY
3090 PO=PO-I*90
3100 GOSUB 2320   :REM/ CLEAR
3110 I=I*-1
3120 PO=PO-I*90
3130 GOTO 3050
4000 REM
4010 REM/ CALULATE PATTERN SUB
4020 H=20+RND(Z)*80
4030 L=20+RND(Z)*80
4040 D=10+RND(Z)*50
```

```
4050 X0=218+RND(Z)*100
4060 Y0=118+RND(Z)*80
4070 X1=320-X0
4080 Y1=Y0
4090 X=X1+L
4100 Y=Y1-H
4105 REM/ 3-2-1-4-3
4110 CALL S1,Y1,X
4120 CALL S1,Y,X
4130 CALL S1,Y,X1
4140 CALL S1,Y1,X1
4150 CALL S1,Y1,X
4160 X3=319-X
4170 Z0=SQR(X3*X3+Y0*Y0)
4180 A5=X3*D/Z0
4190 B5=A5*Y0/X3
4192 X5=X+A5
4194 Y5=Y1-B5
4195 REM/ -5-6-7-1
4200 CALL S1,Y5,X5
4210 B6=A5*Y/X3
4220 Y6=Y-B6
4230 CALL S1,Y6,X5
4240 A7=B6*X0/Y
4245 X7=X1+A7
4250 CALL S1,Y6,X7
4260 Y9=Y+&8000
4270 CALL S1,Y9,X1
4275 REM/ 7-8-5  DASHED
4280 Y7=Y6+&7700   :REM/ DASHED
4290 CALL S1,Y7,X7
4300 Y8=Y5+&7700
4310 CALL S1,Y8,X7
4320 Y9=Y5+&8000
4330 CALL S1,Y9,X5
4340 REM/ 4-8   DASHED
4345 Y9=Y1+&7700
4350 CALL S1,Y9,X1
4360 Y8=Y5+&8000
4370 CALL S1,Y8,X7
4380 REM/ 2-6 -0  LAST,DOTTED
4390 CALL S1,Y,X
4400 Y9=Y6+&7F00
4410 CALL S1,Y9,X5
4420 Y9=&8000
4430 X9=319
4440 CALL S1,Y9,X9
4450 Y9=Y6+&7F00
4460 CALL S1,Y9,X7
4470 Y9=&8000
4480 CALL S1,Y9,X9
4490 Y9=Y5+&7F00
4500 CALL S1,Y9,X5
4510 Y9=&FF00
4520 CALL S1,Y9,X9
4530 RETURN
9999 END
```

Documentation

Merlin's documentation is truly great! If I've seen better I can't remember where. There are currently over 210 pages. Even at that, MiniTerm is working on more! The kit assembly instructions were a lifesaver. When I took my Merlin manual home, I had *never* built a kit! As it turned out, I used parts of the Merlin manual for assembly of other kits. There is a general section on kit building with things like how to put sockets into a printed circuit board for soldering. They gave four ways and said to try them and choose. Remember, some kit manufacturers feel that one page is sufficient! Each page of the assembly instructions has a picture of the board used in the steps on that page, with the areas circled where you insert parts. Possibly one of the highest praises I can give these instructions is to say that I have since built a Healthkit scope and found the documentation to be of that caliber.

My Experiences

My experiences with Merlin have been very good. After assembly, the basic unit ran the first time, even with an error I found later with MiniTerm's help. I did have a problem with free mode, but it turned out to be a sensitivity to dynamic memory. MiniTerm had a fix for this, but I never used it as the dynamic memory was in a system I borrowed for testing the Merlin. When I started running on my 4MHz system another problem arose. The display would switch to a section of memory which I had not requested, and then come back. This was my one assembly error. Merlin now runs solid as a rock at 4MHz. I am still amazed that it ran at all with the error present and feel this shows a good design.

Although the 3 day delivery of the basic board was great, the delivery on the MEI ROM and MCAS units was another story. However, MimiTerm is well aware of the problem and (allegedly) has taken steps to overcome it.

The technical assistance was very good. For the few problems I had, I got answers to the questions I asked, as well as a few I hadn't. The people at MiniTerm reflect an attitude of pride in Merlin, and assume that they also have a problem, not just the customer.

My Conclusion

Merlin is not the Video interface for everyone. If all you want is a plain TV Typewriter, you can buy cheaper interfaces. On the other hand, there are those who want "more!" For those people, expert and novice alike, Merlin should do the job. As you have seen, my Merlin provides me with a great I/O subsystem, and MiniTerm have a track record of providing new add-on options, showing that they have not forgotten that customers have an investment in their product.

All I can say in closing is that I anxiously await more Merlin upgrades. After all, King Arthur's wizard must perform in color! ■

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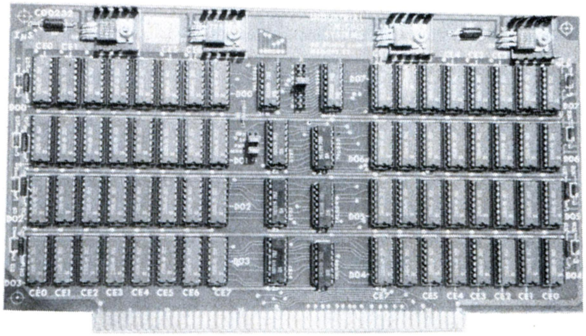

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Bally Professional Arcade

Karl L. Zinn

You can now plug a resident Basic into a home video game. The package, including ROM cartridge and a good, printed introduction to Basic, sells for about $50. For $50 more you can get a tape cassette interface for saving programs. The initial purchase (processor, built-in arcade games, keypad and four joysticks) is about $300. I don't get excited about arcade games, especially at $300 purchase price for home use. However, I am very pleased to see a convenient $50 option for a family having a video game to now move into programming the microprocessor themselves. Music, color, and 1800 bytes of program storage make the programming quite interesting.

In this review I won't try to analyze the Bally Arcade as a games product, or compare it with Atari or Fairchild or RCA. I will provide some commentary on Bally Basic as a significant extension of the Bally machine and an interesting enhancement of Palo Alto Tiny Basic. Also I will include a comment on advertising and availability of such products in general.

I appreciated the help of John Johnson of NCE/Compumart in Ann Arbor, not only for the loan of the only Bally Basic cartridge in the area but for advice and assistance in exploring the language.

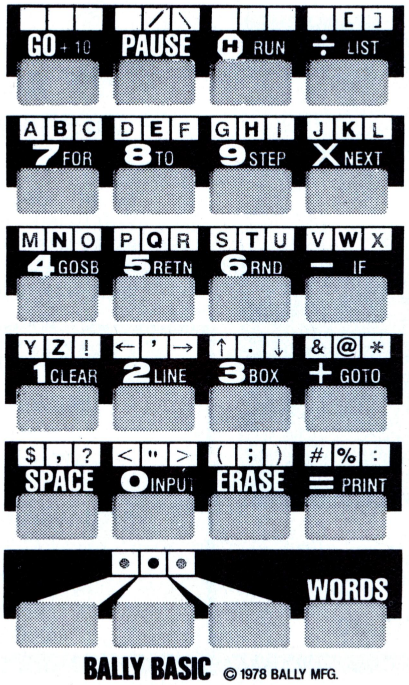
The arcade as a basis for educational use

Bally Basic™, written by Jay Fenton, is a version of Palo Alto Tiny Basic expanded for control of graphics, color, sound, and joystick input. An instruction booklet by Dick Ainsworth provides an easy introduction in about 36 small-format pages.

The 24-key numeric pad is converted by an overlay which designates control keys, alphabetics and Basic statements. Four prefix keys across the bottom are used to make the 20 other keys suffice: one for "words" to indicate RUN, LIST, FOR, GOTO, and so on; and three for indicating which character on each key is desired (A, B, C or &, @, *). Color codes help with this arrangement. Numbers, operators, space and some control characters (GO, PAUSE, HALT, ERASE) are boldly presented in white; they require no prefix. Words are printed in gold on the overlay, and when the WORD prefix key is pressed the screen background turns gold as confirmation. The screen color changes back after any key with a word on it is pressed, and that full word (e.g., PRINT) appears at the next position in the program listing. Alphabetics are in green, red, and blue with corresponding colors on the overlay and screen background.

In addition to color aids the location of characters is reasonable, left and right parens, brackets, slashes, arrows, and the like are on the left and right respectively of each cluster of three characters on a key. The effect is one of soon changing the user's "hunt and peck" to simple "peck." The non-typist will go just as fast as a typist and perhaps with less frustration; a small, function-oriented keyboard is somewhat of an "equilizer."

I didn't achieve true touch typing. For one thing the key pressure required is a distraction just as on some calculators the feel of the keys is not suitable to working blind. Nevertheless, after a few hours of use I was moving immediately without distraction to all common commands, characters and letters of the alphabet. The audio and color confirmation provides unobtrusive support.



The instruction book begins with very simple programs and does not assume any computer experience. I have not had occasion yet to use Bally Basic with complete novices for anything more than a demonstration. I expect we will find, as with other beginner packages, that having an experienced user at hand is very helpful to answer questions and provide encouragement. The booklet includes pictures of program steps, results and diagnostics as they appear on the screen. This confirmation of what things should look like is very helpful for beginners. Also the reader is led through the operation of a variety of programs step by step. This detail helps clear up confusions which could not be anticipated.

Bally Basic has no confusing diagnostic messages; indeed it has almost no diagnostics at all. When it can't parse (recognize) what is entered it responds "WHAT?" And when it recognizes but can't execute a statement the response is "HOW?" When it runs out of memory it says "SORRY!"

Extensions for use of games capabilities

Foreground and background color are controlled by placing a number in reserved variables FC and BC respectively. One common way of controlling these is through the knobs on the joysticks, as in doodling or graphic art.

Music is fun and easy to do. The sound in the speaker is controlled by placing characters in a reserved variable (mu) as for color. These sound codes can be assigned literally or computed. Advice on semi-random music generation is included. The tempo is controlled by the reserved variable NT (note time). A program listed in the introductory booklet sets up the Bally as a "player piano." The "player roll" is entered from the keyboard and saved for repeated plays.

LINE and BOX commands provide important extensions for graphics. The addressable resolution is 159 dots wide by 87 dots high. The graphics pointer begins in the center (0,0) and will on execution of LINE 24,15,1 draw a line from the origin to the point (24,15) in Cartesian coordinates, leaving a black line (1) connecting the points. (Other

Bally
arcade

kinds of connections are white, reverse and none.) Random and semi-random line drawings are fun; line graphs are easy. Similarly one can put boxes on the screen with additional parameters specifying the width and height of each box. The user soon is putting semi-random visuals on the screen with "music" coming over the audio.

Those who have used the Bally for arcade games know the joy stick (hand control) has a knob for "analogue" input (actually it is read as integers from 1-128 at about 7 o'clock around to +127 at 5 o'clock) and a trigger for marking events. Bally Basic makes these inputs available to the programmer so user programs can include doodling, controlling the position of a space ship, and firing rockets.

A single string array is addressed by @(n) where n can have values from 1 to 874 (by my test). One can store a character or a (signed) number in each location of the string and retrieve them as connected strings through iteration involving the subscripted "@" variable. Since these characters are stored in a separate memory, essentially all of the 1800 bytes of user storage can be used by program statements (key words each take one byte; line numbers and linkage require three bytes). Revision of programs is accomplished by adding, deleting or replacing entire lines.

Bally Basic does have limitations, of course; it is helpful not to expect too much. I have already mentioned lack of storage, speed of animation, and access to machine functions. Also it needs an editor, although that is not a problem with short lines. Nevertheless Bally has provided a significant step, for only $50, beyond arcade games.

The manual provides an easy beginning and suggests interesting things to do. Indeed, a library of the programs in the manual is sufficient for now to impress neighbors with one's control of the machine. The programs and annotations have been written in a way to encourage doing more. The capacity of the language and machine go way beyond what is demonstrated by programs in the manual, i.e., longer programs and more complex control. I tried the machine with two preteens (already programming in Basic) who put some interesting games into the Bally. Both of them still prefer the Commodore PET for programming, but thoroughly enjoyed access to sound and color and joystick control.

Implications for marketing and education

I hope (as I suppose Bally does) that many purchasers of the arcade games

"Guess the Number" in Bally Basic

`5 CLEAR`	Clears the screen.
`10 BC = RND(256)`	Sets a random background color; 16 intensities of 8 basic colors are available numbered 0 to 256.
`20 FC = BC + 12` `30 A = RND(10)`	Sets the foreground color to the next basic color and opposite intensity from the background color.
`35 NT = 1` `40 INPUT "YOUR CHOICE" B`	Speeds up the operation of the computer.

`45 NT = 3`
`50 IF A = B GOTO 80`
`60 IF A  B PRINT "MORE "`
`70 IF A  B PRINT "LESS "`
`75 GOTO 35`
`80 PRINT B "IS RIGHT"`
	Slows down a bit. (NT =3 is "normal")

`85 NT = 10`	Slows down a lot so the music (line 90) can be heard.
`90 PRINT "045680068000"` `95 NT = 3`	Plays "Charge" through the speaker. All computer operations produce sounds (which can be turned on or off). The two 0's following the first 8 produce a 'hold' for three beats. Three 8's would produce three distinct notes whereas a 0 slurs the preceding note.
`100 PRINT (46 spaces)` `110 GOTO 5`	Uses up some time so you can see what you did.

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will want to go beyond them. But is it reasonable to expect purchasers of the $100 tiny Basic to want the add-on full keyboard and the much more capable (8k) Basic to be offered by Bally (for about $500?). The problem is, one needs more access to the machine to do the kinds of programs included on the games cartridges: speed of animation, control of color, and so on. For some the experience with Bally Basic could backfire. That is, beginning with the more capable machine would have been a better route to learning Basic and the enjoyment of programming. Nevertheless, the $50 entry is a lot easier to take than $500 for full keyboard and more memory, and many more will at least try their hands and minds at programming. If a majority develops a sense of being able to master the machine, some important educational purposes have been served.

Bally Basic, as now delivered is interesting enough for schools working with video production and even small TV stations or community cable systems. Even those who already have a character generator (typically costing $2000) will find greatly expanded capability for making up titles with the $400 Bally Arcade with Basic and tape interface. This home entertainment equipment offers more for less in generating video displays. It is practical to use in real time, as in walking some text across the bottom of the screen, or in production of a video tape, as in progressive assembly of graphics incorporating a title or credits for a program.

The quality of the picture suffers from going to radio frequency in the Bally (for connecting to common television sets via antenna leads) and back to video signal in the monitor or interface box. Bally should provide a video connector for use with video tape machines and monitors. The improved picture quality will be appreciated by home users as well now that new TV sets accommodate direct video input.

The video game manufacturers (see Exidy's Sorcerer as well as Bally arcade) have led the way with pluggable software, an extremely important concept for educational use of personal computers. This is not surprising since they are accustomed to producing pluggable games. Probably by the publication date for this product review, TI will have announced its entry in this area. Keep in mind the long experience of TI in Solid State Software™ for the TI 58 and 59 and the impressive 256 kilo byte plug-in memory (actually two chips) for the Speak & Spell™.

I am hopeful that Bally Basic will lead purchasers of arcade games to try out programming and find some enjoyment in creating their own games or other simple routines. Their disappointment at not being able to match the complexity and pace of the professionally prepared games will be compensated by a sense of control through their own programming. Bally Basic does provide access to color, motion and line drawing, joystick input, and musical tones. Users should be advised that the programs will not execute as fast as those in machine language, and of course they can not be as complex or detailed due to storage limitations. Incidentally, the demonstration program is rather impressive, filling available storage to within one byte and showing off the full range of features.

Advertising and product availability

Perhaps many of you have seen the same JS&A ad I read in the *Scientific American* (September 1977) and many airline magazines for the Bally Home Library Computer. It offered a professional computer for under $300 with the fun of arcade games too. Actually it described a games computer which with some additions would become a professional machine. Riding along on the advantages of large volume production for home games, the same basic unit was to be adapted and extended for professional uses. And JS&A claimed to have "a small console unit manufactured exclusively for JS&A."

A colleague ordered the machine at once and kept me informed during a long succession of conversations with JS&A. Delivery slipped from the four weeks stated in the ad to Thanksgiving, then Christmas, then early in the year. Finally in mid-March, about three weeks after I obtained a plain Bally Arcade machine at a local store, my friend received delivery from JS&A.

Then began a series of conversations with JS&A about how the Home Library Computer differed from the one I obtained through the Bally distribution network. One proposed advantage was in the design, another in quality control, another in price or schedule of deliveries. On each occasion the effort to confirm the difference came up empty. That is, the item sold in the arcade box appears identical but for label and advertising to the one sold through the mail by JS&A, except for minor changes attributable to different production runs. And the performance of our two early machines, one from JS&A and one from Bally, was poor. Both of us had problems with overheating, poor signal strength for the RF input to TV antenna leads, and erratic connections for the peripheral devices (joysticks). A later unit from Bally does not show any of these problems. And JS&A was very prompt in crediting my friend's account when he returned his equipment.

I won't try to place blame for misleading advertising. Whether Bally did not deliver to JS&A as soon as promised or JS&A promised more things and sooner than Bally had committed to do is not important. Something does need to be said about such delays and problems that are characteristic of hobbyist and personal computers.

Equipment promised by many different companies has not been made available on anything near the stated schedule. Some may never become available. And yet various companies have taken money in advance payment for products that have not yet been demonstrated to work, or for which development has not yet been completed.

Good finances and a sound design are more important to product success than advance payments by over anxious purchasers. I hope the buying habits of hobbyists and others interested in being in on early deliveries will adjust to reward sound practices and will help the burgeoning industry for personal computing to mature. ■

An interview with Dave Martin, Bally Manufacturing

Ahl: I notice your little keypad has only 24 keys and a selector at the bottom that lets each key equal up to five different things. How easy is that to learn?

Martin: It's easy to learn. And if you don't know a typewriter keyboard, it's actually easier to learn than a typewriter keyboard. You can do it faster. Also the fact that some of the keys allow you to print a whole word without having to type it out letter by letter.

Ahl: Okay, that's certainly handy.

Martin: Right, and it only uses one piece of information in memory, one bit rather than five bits, for example, in the word print. It uses one bit instead of five.

Ahl: Extremely handy as far as conservation of memory space. JS and A, a mail order vendor, have pictured it with a standard keyboard. Is that one of your products?

Martin: It will be one of our products some time in the first quarter of next year. We don't have an exact date yet as to when it's going to be available. We hope to be selling it at the January CES, or have it available and functioning.

Dave kindly explained the many other attributes of the Bally, however these are discussed in greater depth in Karl Zinn's review.

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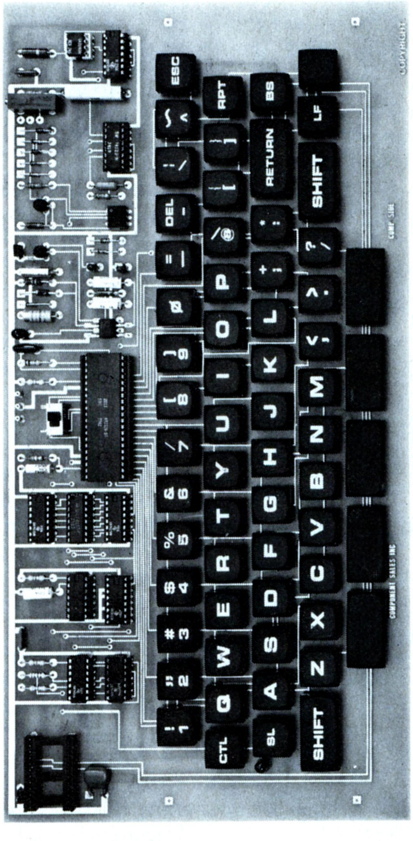

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Two new electronic learning aids from Texas Instruments

Speak & Spell Spelling B

Karl L. Zinn

Education in the home through computer assistance has just been moved ahead a year or two by the introduction of a new electronic learning aid by Texas Instruments. The Speak & Spell™ includes memory (256 kilobits), logic (speech synthesizer), and new modes of interaction not expected for at least another year.

Perhaps my enthusiasm will temper with more exposure to the machine, and with results from trials in the schools. So far I have tried the machine only under rather unfavorable conditions (noise and bustle of the Consumer Electronics Show), and I talked at length with two of the people who had a great deal to do with packaging the device and developing supporting materials.

So this product review will talk mostly about significant trends in capabilities of hand-held learning aids, and implications for educational computing generally. For a later issue I will get some users to report on initial use in schools and homes.

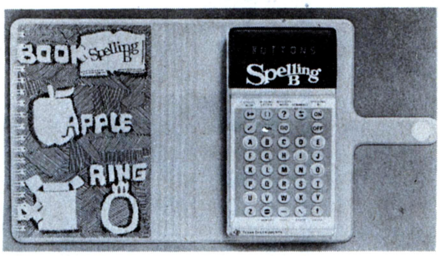
Establishing a Growth Trend

Some years ago someone, wondering what to do with calculators that were discarded due to faulty displays, wired in red and green lights in place of the LED's to confirm if a user keyed in a correct expression and its value. This new application of calculators gained the attention of math educators and CAI developers when the device was redesigned to generate the expressions at random but within constraints of reasonable problems for kids.

WELCOME
Speak
Spell

I first saw the TI Little Professor™ in the fall of 1976. At that time I was impressed by the amount of expensive CAI math exercise which was replaced by the $25 machine, but I predicted double the capability within a year in a new product. Also, I expected a price reduction of about 50% for the Little Professor.

In the fall of 1977 I saw that TI outdid my predictions. Most will agree that the Dataman™ more than doubled the capability of its predecessor, and it was offered at the same price ($25). Incidentally, the price of Little Professor has dropped to $14 list. I was particularly interested to see group learning activities encouraged with Dataman. For the fall of 1978 I predicted another doubling of capability and the introduction of alphabetics for word drills. Also I expected audio the year after that, a larger display with point graphics, and pluggable software (as on the TI 58 and 59).



Now in June of 1978 Texas Instruments has announced products including all I predicted for this year and next and part of the year after. I should like to make such predictions on when we will see Allan Kay's Dynabook!

I haven't seen the full package for Speak & Spell (the books weren't available yet) and I haven't tried it with children (no one under 18 is permitted in the Consumer Electronics Show). Knowing something of what the TI Learning Center can do in product development and testing, I am confident that the new spelling aid will be enjoyed by kids and will be judged effective by educators.

A talking learning aid

The box has the appearance of a colorful, hand-held toy radio or typewriter. It weighs about one pound and measures about 6 x 10 inches. Forty keys are arranged in four rows of ten with command keys across the top and the characters arranged in alphabetical order.

Spelling words are selected at random from one of four lists of about fifty each and dictated through a small speaker in the top of the case. As the child presses the keys, the machine speaks each letter and displays it on the screen. The ERASE key will take the last letter off the screen. When the child presses ENTER the machine compares the character string displayed against one stored in the chip along with the bit string which provided the vocalization. If the two match, the machine confirms "That is correct" and goes on to the next word. If they don't match the machine prompts for a second try. After two errors the correct answer is spoken and spelled.

The SAY IT key, also labeled by a "speaking" cartoon face, provides dictation with a pause for the child to pronounce each word, after which the machine repeats the word. When the ten words chosen at random within that difficulty level have been spoken, the machine proceeds with the regular spelling mode, presenting the ten words in a different order. Each word is spoken once, then again as part of the confirmation after the child has spelled it correctly (or missed).

A REPEAT key causes the current word to be spoken again, and REPLAY key restarts the exercise at the beginning of the current list of ten words. (Each key carries both a word above or below it and a single symbol on the key as a reminder for kids who can't read or remember the function.) Four other keys control three kinds of games. MYSTERY WORD is a version of "Hangman" in which one guesses letters in an unknown word one at a time. With the CLUE key one can "buy" a letter which is part of the word and see where it appears. SECRET CODE is based on a one-to-one translation of the alphabet into another ordering of the characters; on pressing the CODE key the machine will code any string that shows in the display. Pressing LETTER simply calls a random letter generator for a variety of games set up by the activities booklet.

The attractiveness of this new machine is partly due to the novelty of synthesized speech with random selection from a large file of words. However, the designers did a good job fitting spelling drills and word games to the technology of synthesized speech that TI had been developing for some time. Many other things might have been done with a synthesizer that would not have been as attractive and engaging as a learning aid.

The unusually good quality of audio, compared with other systems available now, results from the use of a model of the human vocal system contained in the synthesizer chip.

Instead of generating phonemes from phonetic spellings of the words, a bit pattern is stored in memory for the entire word or phrase. These patterns are taken from human speech; hence, TI can redo the memory chips for the UK with a British actor reading the words. Indeed the same machine can be used for second language learning or medical technology with a change only in the ROM's which hold the voice patterns.

The present product was designed for the home market. Parents will be intrigued by it; kids will enjoy it. Educators might want a volume control and/or headset to accommodate use in the classroom or study hall.

Minor problems

If the child presses a key before the processor is ready for the first character, that is, before it has finished speaking the word, it does not record. Of course, it does not show on the display either. The audio confirmation of each character displayed helps out further. The child only needs to be reminded that the machine won't be listening while it is talking.

I am a little bothered by the clipping of some sounds. However, I was listening under very poor conditions. Actually some distortions might be intentional to help distinguish easily confused sounds. Generally the quality is very good. Incidentally, a few words were left out of the experts' 200 "most troublesome" list because of potential confusions.

At times one would like to have a clock, especially for games with the machine. I recall the advances in motivation and group play from uses of Little Professor to Dataman because of a visible clock and time reports.

Some other uses

One might change the colors of the packaging and labels next to the keys for other ages of learners. I expect Speak & Spell could be helpful drilling students in medical sciences and technology on terminology. The ROM could be set up for the machine to speak one phrase and check the user's response (up to eight characters) with another word or code. The memory structure pairs a bit string for the audio (any word, short phrase or other sound that can be handled by the synthesizer) with any character string for the anticipated answer.

Second language learning seems a natural application, especially with a large collection of vocabulary chips. I wonder how easy it is to change the logic of the learning exercises and games. For some applications the machine should first display the character string as a prompt for speaking.

In industrial settings use of the machine could help establish common language conventions for new employees in a situation of rapid turnover. The list of potential applications goes on and on.

As an option on terminals

How many people would be interested in a 200-word audio output device as an inexpensive option on terminals? It should not add much to the price. This year TI is providing a great deal for $50 in a home product. Consider what 256 kilobits of ROM costs. Yet in two years we will probably have four times as much for the same price. Incidentally, TI will probably sell the plug-in ROM, presently on two chips carrying about 200 words, for about $10. The figure will be determined by the market. Even if the price doesn't cover initial production costs, soon it can be profitable.

I see prospects for Speak & Spell as a peripheral on other machines. Even with the present version one could come in through the keyboard interface or perhaps the memory module connector.

I would like to see the machine used as an output device on calculators and other equipment for the blind since it provides a significant improvement in quality for a much lower cost. (Telesensory's talking calculator is $400.) Also I expect the technology to soon find use in speaking aids for those without sufficient control of their vocal mechanisms to be understood by inexperienced listeners.

A speechless companion

Spelling B™ was not ready in time to show any more than a prototype case with a picture book at CES. I did see that it complements the talking machine in games and exercises. It is small enough (about 4x6 inches) to slip in a large pocket, being similar in format to Little Professor and Dataman. A friend or parent can type in up to five words for the child to spell as the machine presents them one at a time in random arrangement. The missing letter key will set the machine to presenting words from its list of 264, each time with some characters missing, to be completed by the child. Hangman is there too, called "Mystery Word."

The basic mode of use is in spelling the words for pictures which are given in the accompanying book. The machine prompts with the number, randomly chosen, for an object to be spelled. Spelling B has its word list divided into three levels of difficulty suggested for kindergarten through fourth grade. Deliveries are scheduled to start in September with a suggested list price of $30.

A marketing strategy is emerging which separates the learning aids from calculators and also from toys. TI plans to support merchandisers in establishing a Learning Center concept for the display area providing a collection of electronic aids for spelling, reading and time telling as well as computation. You will probably see extensive television advertising at times chosen to influence back-to-school and holiday gift purchases. But this is more than just an advertising campaign. The TI Learning Center in Dallas is working hard on educational design, getting advice from persons expert in language arts and math skills, and testing extensively with learners, parents and educators of varying background and geographic location.

Impact on personal computer market

I predict dramatic impact of hand-held electronic products (from $10 to $50) on the personal computer and video games market. Presently I find the presentation of math drills on the Bally Arcade less interesting than similar ones on Dataman. Math Bingo on the Bally and Maxit on the Commodore PET are much more motivating.

Consider how soon the hand-held devices will get sufficient display size and point graphics to compete with what is done with a TV raster on a personal computer. Think about how the two kinds of products and their various markets may be coming together. We should be seeking out the crucial contributions of general-purpose personal computers in contrast to the less expensive and easier-to-use, special-purpose learning aids.

Trends

The significance of the introduction of these two new products by TI is the trend line. Consider how long it took to go from early photography to movies to talkies to home films. Or the elapsed time from phonographs to wire recorders to pocket tape machines. Electronic calculators have moved into hand-held learning aids in just a few years, and the technology that makes it cheaper and more capable every year is expected to continue to improve at about the same fantastic slope for at least twenty years.

The producers of personal computers need to take notice of the role of hand-held products in areas previously the domain of general-purpose and more expensive machines. And the educators (including parents) should seriously consider adopting both kinds of learning aids before the end of this year. ■

A Creative Computing Equipment Profile...

Computalker CT-1 Speech Synthesizer

Steve North

"Don't touch that switch!" shouts your computer, as you reach to turn it off. *Very* unlikely, yes, but possible—if your computer is equipped with a Computalker. The Computalker CT-1 is an S-100 bus board capable of generating high-quality synthesized speech, through an external audio amplifier.

The Computalker hardware allows a high degree of control over the sounds it makes. It's programmed through a set of I/O ports addressed at EO-EF hex (some of these ports are reserved for future expansion). The I/O ports control the fundamental parameters that compose human speech: amplitude of voicing, voicing frequency, the three formant frequencies, and some other amplitude and frequency parameters. There is also provision for control of the speech pitch by an external square-wave clock, thus suggesting the possibility of a "Compu-singer"! The square-wave source could be a computer music board within the same system, though the software and timing complexities get a little mind-boggling.

To create intelligent speech, the I/O ports of the Computalker must be programmed with the correct values in sequence to form the speech at fairly close intervals — about every 10 milliseconds, depending on the desired rate of speech. And because there is so much information to be processed to obtain natural-sounding speech, the overhead software is somewhat complicated. This is just one of the tradeoffs involved in a device with a great deal of built-in flexibility. But by fine-tuning the speech data, it is possible to get very intelligible and almost human-sounding speech. Contrast this with the Ai Cybernetic Model 1000 speech-synthesis unit (reviewed in the May-June 1978 issue of *Creative*) which relies on a rather trivial software routine for its operation, actually of no more complexity than that of a routine used to drive a Teletype. The end result is that speech generated by the Ai Cybernetic unit suffers from a rather choppy, mechanical effect, but it is a snap to interface the 1000 to almost any software (such as BASIC). Of course another advantage to the Computalker's dependence on software is that it's much easier for both the manufacturer and the user to improve the performance of existing units by modification of the software.

The Computalker may be driven with either of two software packages provided by Computalker Consultants. CTMON, a speech-synthesis monitor program, comes with every Computalker. It must be used in a computer with a keyboard, papertape reader/punch, audio cassette, and a VDM-1 or similar memory-mapped video display. [Ed. note: By the time read this, CTMON will probably be replaced by CTEDIT, which does not need a memory-mapped video, and will work with Teletype, TVT, serial display, etc.] CTMON allows creation and modification of a table of speech data, divided into "frames." Each frame contains the set of data that must be programmed into the Computalker's different I/O ports for each time interval (10 msec). By programming a whole series of these frames, you can make the Computalker speak a single word. (There are roughly 70 frames in the word *hello*.)

Conversion to Frames

The conversion of speech into numerical data frames is a slow, painstaking process, requiring access to a spectrum analyzer (so you can examine the makeup of natural speech) and a good knowledge of exactly how speech works. Unfortunately, most personal-computer users lack these. The manual suggests that it may be possible to use a microcomputer with a filter, A/D converter and floating-point hardware to assist in the conversion process, but this technique has not been much explored. Computalker can also do a rough conversion of your audio tape for around $25 per second of speech, and then you must do some work on your own to polish the speech. If you want to avoid this slow and/or expensive conversion process, you can try out some of the demo tapes that Computalker provides for use with CTMON, which contain the speech synthesis data for speaking the numbers 0-10, letters A-z, and the message: "Hello, I'm Computalker, a speech synthesizer for your standard-bus 8080 microcomputer." These messages are highly understandable and demonstrate the quality of which the Computalker is capable. However, for most applications, it is desirable to be able to create your own unique messages, with a minimum of effort. Otherwise, when limited to a small dictionary of messages, and capability of synthesized speech isn't much more useful than just a set of prerecorded messages on audio tape. (An exception: when you want your computer to read your BASIC programs or hex dumps out loud while you consult a printed listing, it is quite helpful to have a *few* words spoken *well*.)

Synthesis by the Rules

The other software package, CSR1 (available at $35) fills this need. CSR1 is a speech-synthesis-by-rule program, consisting of six modules and a top-level monitor program that handles interaction with the user through any ASCII terminal. CSR1 lets you enter a message to be spoken in a special phonetic language, called ARPABET. The phonetic language allows expression of most sounds with one or two upper-case letters. The message entered by the user is processed by several rules (which may modify the input string to sound more correct) and eventually produces a speech data table like that used in CTMON. The phonetic language contains 29 consonants, 19 vowels, punctuation marks ("?", "," and ".") and some other special symbols. It seems easy enough to get reasonable quality synthesized speech just by using the famous Chinese Menu Algorithm (one from column A, two from column B, etc.) but with some practice and an idea of what sounds normally go together, even better quality is possible. According to the CSR1 manual, the consonants are fairly easy to pick out, but some care must be taken with the vowel sounds. The speech generated under CSR1 is not as understandable as that made by manually preparing the speech data with a spectrum analyzer and CTMON, and you won't mistake it for natural speech, but it is acceptable. The punctuation marks are helpful, since the machine can't really know what kind of inflection to add, and this gives you some degree of control (along with the option of assigning a stress value to vowel sounds by postfixing a numeral from 1 to 5). The Computalker under CSR1 still sounds better than the Ai Cybernetic Unit, at least to these ears, and while it does require a lot more software to make it go, it's certainly worth it to achieve better-sounding output.

The top-level CSR1 monitor program permits only entry of a new line of phonetic speech, line delete (control-X), play the previous message (control-P), and a hex dump of the previously generated speech data (control-B). In the event that you want to have synthesized speech under the control of some other program (meaning that you want to do more than type in phonetic messages and hear them spoken back at you), then it is possible to call CSR1 as a subroutine from your own main program, in lieu of the CSR1 monitor program. All you need to give CSR1 is a pointer to the string of characters in memory that contain the message in phonetic language. (In BASIC you would have to POKE the message into some place in memory and then call CSR1 as an assembly-language subroutine). Keep in mind that both CTMON and CSR1 eat up significant amounts of memory: CSR1 runs from 1000 to 5FFF hex (a 24K system) and CTMON uses 100-800 hex and anything upwards for buffer space (the LETTERS data uses 10K bytes). Source code and I/O patches are provided for all the software. The software itself is available on paper-tape, cassette, or diskette. (We didn't try the diskette version, but hopefully the assembly-language source of the software is included to encourage tinkering, since few people have the time to manually key hundreds of lines of source code). The quality of the documentation is high.

Interaction with CSR1: Three examples

```
ENTER TEXT:

KRIYEY4TIHV KAAMPYUW2TIHNX.
```

The phrase "Creative Computing" looks a little strange unless you know that the vowels are expressed as two-letter combinations (such as IY for an *ee* sound), and the letter X is always part of a two-letter combination. The period is used for inflection.

```
ENTER TEXT:

WAH2N.TUW2.THRIY2.FOH2R.FAY2V.SIH2KS.SEH2VEN.EHIY2T.
                                        NAY2IYN.TEH2EHN.
```

The numbers 1-10 in the phonetic language. The numerals (such as 2 in the word WAH2N) control the stress.

```
ENTER TEXT:

AY WIH2SH AY WAAZ AX KEH2LAOGZ KOH3RN FLEHYKHH.

ENTER TEXT:
AY  70 59 55 96 9B 00 00 80 00
    BA 58 55 96 9B 00 00 80 00
    E0 56 55 95 9B 00 00 80 00
    E0 55 56 94 9B 00 00 80 00
    E0 53 58 93 9B 00 00 80 00...
```

The sentence "I wish I was a Kellogg's Cornflake," or at least a rough approximation thereof, followed by a portion of the speech-data table generated from this input. This is what you get when you type control-B.

Tight Fit

The only objection I have is that it's a bit difficult to fit CSR1 and BASIC in one system. CSR1 leaves 8K of memory below it, which isn't enough for an 8K BASIC and a program, so it's just wasted space. If CSR1 a was lower, then a relocatable BASIC (such as TDL—uh, I mean, Xitan BASIC) could be loaded above it and could call CSR1 from a BASIC program. CSR1 is available in a high-memory version, though, so you can keep CSR1 way up out of the way and have BASIC down in low memory. Obviously, if you have the source it can be assembled wherever you want.

If you're shopping around for a speech synthesizer, or just something new to try out in your computer, then the Computalker is a good choice. It's the best performing and most flexible speech synthesizer board we've tried so far, and has the potential for even better performance with improved software.

Availability

The Computalker CT-1 synthesizer board, plus CTMOM (or CTEDIT) parameter editor program, is $395, at your local computer store, or from Computalker Consultants, 1730 21st St., Suite AE, Santa Monica, CA 90404. ■

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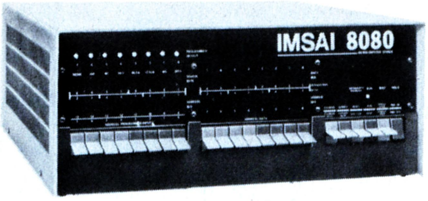

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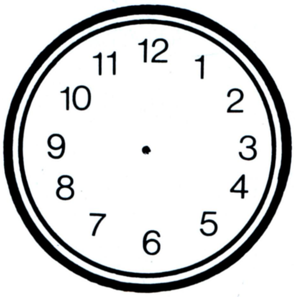
puzzles &



An hour ago, the time was four times as many minutes past 1:30 as there now are minutes until four o'clock. What time is it?

The Mathematics Student

Thinkers' Corner

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MATHEMATICS PUZZLES

How many of the problems (a) through (f) below can be solved by forming an expression equal to the GOAL? (Suppose that each symbol below is imprinted on a disc.)

The expression must use:
(1) only single digits combined with operators,
(2) all of the discs in the REQUIRED column,
(3) as many of the discs in PERMITTED as you wish, and
(4) at most one of the discs in RESOURCES may be used.

	The "*" indicates "to the power of". Thus 3*2 = 3² = 9.
Special	The 'V' indicates "the nth root of". Thus 3V8 = 2.
Rules	Parentheses can be inserted anywhere to indicate grouping, but never to indicate multiplication.

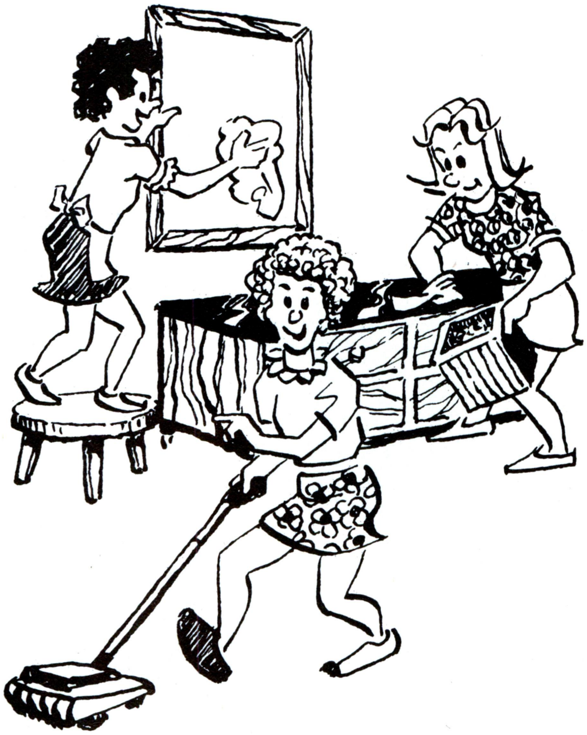
PROB.	GOAL	REQUIRED	PERMITTED	RESOURCES
[a]	15	3 8 +	1 4 =	+ − x 2 4 6 8
[b]	7	2 x	5 8 −	+÷ V 1 3 9 9
[c]	5	3 ÷	2 9 x	+ x ÷ V 4 5 8
[d]	12	1 −	6 7 8	− ÷ * 2 5 8 8
[e]	1	3 + ÷ 6	4 6 x ÷	+ − x 0 1 2 3
[f]	14	5 +	3 6 *	+ − V 2 5 8 9

Some suggested answers (frequently there are others):

[a] 3 + 4 + 8　[b] (5 x 2) − 3　[x] (9 ÷ 3) + 2
[d] 6 − (1-7)　[e] (1 ÷ 3) + (4 ÷ 6)　[f] (3 * 2) + 5

If you enjoy this kind of puzzle, you might like playing EQUATIONS: The Game of Creative Mathematics. Free information about this and other instructional games is available upon request from The Foundation for the Enhancement of Human Intelligence, 1900-E Packard Road, Ann Arbor, MI 48104.

problems



If Alice and Betty can complete their jobs in 2 hours and if Alice and Charlene can do the same work in 3 hours, while Betty and Charlene require six hours to do the same jobs, how long would it take each girl working alone?

Igor, Ivan and Dornatz are all giraffes. Igor is as old as Ivan and Dornatz together. Last year Ivan was twice as old as Dornatz. Two years from now Igor will be twice as old as Dornatz. What are the respective ages of the three giraffes.

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The Future is Here Today

Susan Hastings

Human beings have always been curious about the future. They've peered into crystal balls, examined human palms and animal entrails, shuffled cards, and prayed for divine guidance — all in an effort to prepare themselves for changes to come.

But change has never been so constant and overwhelming as it is today. That's true not just for individuals, but for human organizations as well. Recent events like the first resignation of a U.S. President, increasing unemployment paired with inflation, and the political emergence of resource-rich developing countries have made managers and organizations realize that they must develop better methods for adapting to the trauma of organizational future shock. If they can't adapt, they will fall by the wayside.

Most organizations plan for the future with budget estimates or sales projections, but the changes being experienced today are so fundamental that they cannot be predicted by the traditional methods of merely examining the past. To quote management expert Peter Drucker, "The most accurate quantitative projection never predicts the truly important: the meaning of facts and figures in a different tomorrow."

Of the 500 largest industrial corporations listed by *Fortune* magazine in 1955 only about 57% were left in the 1975 list. Many of the lost companies disappeared because they could not adapt to the new tomorrow that suddenly faced them.

The trauma that surprised and ruined many organizations was often a result of too much dependence on the past. Continued breaks from the past face industry today and those breaks might be almost anything: the refusal of developing countries to accept U.S. dollars for their oil and other resources; severe climatic changes endangering America's agricultural heartland; organization-directed nuclear terrorism; or even the sudden emergence of an irresistible worldwide outcry for disarmament and peace.

Events such as these might seem absurd until they happen, and many organizations opt to disregard the possibilities. However, a small but growing number of farsighted organizations is applying advanced forecasting methodologies to their long-range planning efforts. They are using techniques such as Delphi polling to discover how informed experts view the distant future. Cross-impact analyses also are made to trace the effects of one innovation upon another and scenarios are built to produce vivid pictures of the future in the way George Orwell did in his book *1984*. Finally, computer-driven systems analyses models which process mountains of facts are used to try to forecast things to come.

The new "futurists" require enormous amounts of good information and the ability to minimize perceptual biases when collecting and analyzing it. The information they utilize is of two types: quantifiable "hard" data which is usually economic and scientific in nature, and non-quantifiable "soft" data which tends to be more societal because it deals with changing human values, aspirations and demands. Yet, despite the quality and quantity of information available to help forecast the future, the problem of human perception in selecting and analyzing it is a major one. Futurists must be able to step outside of their own — and their organization's — traditions, values, and taboos in order to recognize and analyze early-warning signals of what lies ahead. And even if the futurist succeeds admirably, the report might be filed away and forgotten by management because it bumped into the organization's sacred cow.

Change can never be managed

effectively unless an organization perceives the need to change. Rigid organizations which repress change hasten their own demise. Today however, attempts at scientifically analyzing the future are being pursued by cities, states, trade associations, medical societies, universities, labor unions, foundations, churches, and citizen activist groups as well as the larger and more powerful corporations and government which pioneered future studies.

The study of organizational futurism is also growing vertically as more and more subdivisions within organizations are being charged with foresight responsibilities. A timely illustration of this is the enactment of new Federal legislation requiring that every committee in the U.S. House of Representatives (except Budget and Appropriations) "undertake future research and forecasting on matters within the jurisdiction of that committee."

While futures studies are still in their infancy, all citizens, but especially those in management positions, should be encouraged to participate in planning for tomorrow. Studying the future is fascinating to do; it can help one to manage better, and it can be a mind-expanding experience.

A growing number of colleges and universities now offer courses in futures studies, but anyone interested in improving his own ability to forecast the future can do so on a more informal basis. Alvin Toffler's now classic book, *Future Shock,* is probably the best introduction to the study of futurism. It is "about what happens to people when they are overwhelmed by change . . . about the ways in which we adapt — or fail to adapt — to the future." The daily newspaper is also an excellent futures textbook for studying the changes in our lives. Simply by watching and talking to other people one can gain insight into the events and attitudes that are fashioning the world of tomorrow.

Trying to forecast the future by thinking about second and third order consequences of future developments and alternative futures can be done alone or with others on an individual, community, or organizational level. Futures analyses can help to define goals, and give one the opportunity to work toward the future he prefers. Tomorrow will always arrive right on schedule. In order to make it the best tomorrow possible, think about it today. ■

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CIRCLE 124 ON READER SERVICE CARD

A Creative Computing Software Profile...

PET Cassettes from Peninsula School

Steve North

It seems that almost everyone and his computer are hawking Blackjack and Lunar Lander for the PET on cassettes these days. So it was quite a relief to find some really different, interesting PET software on cassette, available from the Peninsula School of Menlo Park, CA. (One immediately suspects some kind of tie-in with People's Computer Company.) The Peninsula School offers three cassettes with ready-to-run programs. As one would suppose, all the programs are more-or-less educationally oriented, but they're a lot of fun even if you're not trying to learn anything. All the tapes come with a 5½-by-8½ booklet describing the use of the programs and a complete program listing.

Tape #1

The first tape sells for $19.95, which seems a little steep, but it contains six programs. From a programming standpoint, the most interesting thing about these programs is that they're written, not in BASIC, but in PILOT, a language designed for CAI dialog applications. But, because the PET itself only knows BASIC, each program also includes a PILOT interpreter written in PET BASIC. Thus, to run a PILOT program, you have PILOT being interpreted by a BASIC program, itself interpreted by a BASIC interpreter. This is not very efficient on memory or time so you get the feeling that someone went overboard for PILOT. One interesting feature of the PILOT is that it outputs word by word, rather than character by character, which is somewhat easier to read.

The first program on the tape, Hammurabi, is rather close to the BASIC version of the game that has been around for a while. Unfortunately, we couldn't load this program into our PET. Our PET cassette has been aligned at a Commodore Repair Center (a story in itself) so we tend to suspect THEIR PET, which is standard procedure when you can't load someone else's programs. The other programs on the cassette (they worked!) are simpler dialogs: GOLD (modified version of Goldilocks and the Three Bears), SKY (A conversation with the PET about things in the sky), NAMES (a dialog about names), and HANDS (which encourages you to write a poem about your...). A copy of PET PILOT without any PILOT program is included. Overall, these programs are nice dialogs for introducing kids (or anyone) to a computer, but the almost-$20 price tag is too high, unless you're really dying to use PILOT.

Tape #2

Tape #2, which sells for $14.95, includes four programs. We never got LEMON to load, but a look at the documentation booklet reveals that it's a simulation of a lemonade stand, designed to give the user experience in handling money and making decisions. In LEMON, you can make a fortune during a heat wave, or spend money on signs for advertising, or have your mother withdraw her free paper cups. RENUMBER is a short program used to renumber BASIC programs, because PET BASIC does not have this function built-in. However RENUMBER does not really RENUMBER programs (with references to other line numbers) but just the line numbers themselves. In other words, 13 GOSUB 132 may be changed to 50 GOSUB 132, but 132 will never be changed. Doing a real renumber is somewhat trickier.

The flip side of the tape has Kaleidoscope and WSFN on it. Kaleidoscope is a program that does nothing but make pretty pictures on a TV screen, much like the TV Dazzler version if you've ever seen it, but not as nifty because the PET version is slower (it's in BASIC) and it's only in black and white. WSFN, *w*hich *s*tands *f*or *n*othing, is a rather sophisticated piece of software, actually a language used to control a turtle on the PET screen. This is definitely not first-grader stuff, since it involves concepts such as moving the turtle on the screen and leaving a trail, an accumulator, branching, and macro-instructions. The manual gives sample macros used for drawing curves such as "Sierpinski curves" on the screen with WSFN. It would certainly take a long time to explore the potential of WSFN. Also, the price of this tape is a bit easier to take.

Tape #3

This tape has only two programs. QUEST is a scaled-down version of Adventure, one of the ultimate computer games in which you explore a cavern in search of treasure while you fight off baddies. One of the interesting things about Adventure (unlike Star Trek, where you have so many commands and this much energy, etc.) is that you never know exactly what options you have or what actions will have what effect, until you try it. In QUEST, you search through a small cavern for a pirate's treasure, avoiding a giant. This is really a lot smaller than ADVENTURE, but still a lot of fun. (Speaking of Adventure, I saw a version in which your cavern is Hill Center at Rutgers. For treasure you can take out an IBM 370/168 or a card reader, but you have to fight off a nasty operator or an insane applications consultant.)

DRAW, on the other side of the cassette, lets you doodle on your PET screen, leaving trails of various characters, blanking them out, and so on. This is an interesting program, but I prefer a box of crayons — they work in color, too. This tape is only $9.95.

In general, the Peninsula School software cassettes are fun to use and educational (although certainly not at the level of, say, the Huntington Project programs). They are indeed much better than the schlock that many individuals are selling. Contact Computer Project, Peninsula School, Peninsula Way, Menlo Park Ca.

■

ASK YOUR DAD ABOUT GIRLS
Bill Holland

COMPUTER SIMULATIONS AND PROBLEM-SOLVING IN PROBABILITY

John S. Camp

Probability is a subject that is used in a wide variety of disciplines. Examples of applications can be found in the study of marketing, population planning, system reliability, and even mathematics, itself. The purpose of this paper is to present problems (and solutions) from these areas to show how a computer simulation can be used as a problem-solving strategy in probability.

In probability, problem-solving often involves the use of known theory [$P(A|B) = P(A \cap B) \div P(B)$] and/or the study of actual experiments that are designed to suggest or give answers to questions of interest. For this discussion, is it the experimental aspect of probability that will be emphasized, for experiments are at the heart of probability and are what simulations are all about.

PROBABILITY AS A MOTIVATOR

Probability is an almost guaranteed motivator. People enjoy predicting the outcome of elections, estimating the chance that a particular team will win a world series, or applying the subject to games of chance. As other examples, consider the following:

Population Planning

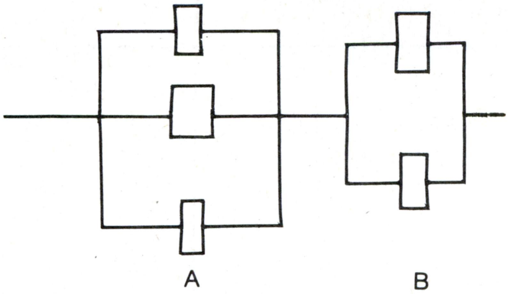
Suppose that you have decided that you want exactly four children in your family. What are the chances that the four children will be boys?

Marketing

Assume that you are responsible for marketing packages of bubblegum and to increase sales you enclose a picture of a famous football player in each package. If there are 25 pictures, what is the expected number of packages of bubblegum an individual would have to purchase to acquire a complete set?

System Reliability

The figure below is an electrical system that was built by using five components arranged in parallel and two small systems, A and B, arranged in a series, If each component has a 60% chance of lasting 1000 hours, what is the chance that the entire system lasts 1000 hours?



Although the problems could be presented "as is," if they are to be used in the classroom they should probably be introduced with a little flair. In the population example, you might ask, "Why is this an important question to some people? Is there anything wrong with all boys?" Students are usually quite willing to argue the *pros* and *cons* of this issue especially when there are boys and girls in the class.

The bubblegum problem is especially interesting to those students who collect cards. Ask if there are any collectors in your class and ask them "How hard is it to acquire the last card of a set?" You might ask the students for a show of hands for how many think it would take more than 10,000 packs of gum, how many think less than 200, and how many think between 200 and 10,000.

In introducing the exercise on system reliability, you might say that the component is an integral part of say a VOYAGER spacecraft and it is important to increase its reliability.

For each problem, a good strategy is to ask students to guess at the answer *before* attempting to solve it. If there are a wide range of guesses, this will cause students to want to find a solution to determine whose guesses are correct. For these examples, most students will be surprised at the answers.

EXPERIMENTS AND SIMULATIONS

Probability tells us something about the "long run." For a fair die, we know that on a single toss of the die,

$$P(3 \text{ showing}) = 1/6$$

and so in the "long run" (i.e. many tosses of the die), I expect to see 3 appear about 1/6th of the time. This "long run" aspect of probability can be used to approximate probabilities simply by collecting data on many trials of an experiment.

Actual experiments, however, may be costly as well as time consuming. For example, one could locate 4-child families and determine the ratio of the number that were all boys to the total. In the case of the electrical system, one could build many, turn them on for 1000 hours and determine the rate of success.

An alternative to an actual experiment is a simulation (representation) of the experiment. When a simulation can be conducted by studying arrangements of random numbers, then the computer becomes a powerful problem-solving tool.

Paper delivered at NAUCAL '77, Dearborn, Michigan, Nov. 3-5, 1977. The author is a professor at Wayne State University, College of Education, Detroit, Michigan.

PROBABILITY con't. . .

SOME SIMULATIONS

The heart of the simulation process is generating numbers at random. The following two methods are rather standard; BASIC is the language that is used.

Method 1: Using a String

```
 10  DIM A$(10)
 20  A$= "0123456789"          The digit string
 30  FOR N = 1 TO 100          Generate 100 numbers
 40  FOR F = 1 TO 4            Each number has 4 digits
 50  Z = INT(10*RND(8)) + 1    An integer between
                                  1 and 10 inclusive
 60  PRINT A$ (Z,Z);           Print the Zth digit
 70  NEXT F
 80  PRINT "      ";
 90  NEXT N
100  END
```

Note how A$ contains the possible digits of the 4-digit numbers that are generated and printed in lines 30-90. The output is 100 4-digit numbers like:

```
    1257        9843        0016     ....
```

where *each* digit of each number has been generated at random. Another method that will generate *individually* produced digits is:

```
10  FOR N=1 TO 100               100 numbers
20  X = 0                        X is the number;
                                    initialize to 0
30  FOR F = 1 TO 4               4 digits in X
40  X = 10*X + INT(10*RND(8))    Successive passes
50  NEXT F                          through F loop "fills" X
60  PRINT X;
70  PRINT " ";
80  NEXT N
90  END
```

Method 2: Generating a number between *a* and *b*

In some systems, $0 \leq RND(8) < 1$ and so

$$0 \leq (b-a) * RND(8) < b-a$$

$$a \leq (b-a) * RND(8) + a < b$$

To generate 100 4-digit numbers, run

```
10  FOR I = 1 TO 100
20  Z = INT (1000*RND(8) + 2000)
30  PRINT Z;
40  NEXT I
50  END
```

Note that $1000 \leq Z < 3000$. The output is 100 4- digit numbers like

```
    1257        2639        2411     ...
```

where *each number* has been generated at random (rather than each digit of each number).

Population Planning Simulation

Depending on the students and their backgrounds, 4-child families can be simulated in a number of ways. One method is to generate 4-digit numbers, as in Method 1 of this section, and for each number, let an even digit represent a boy, an odd digit a girl. Students can count the results. In the run of 100 numbers that follows, there are exactly 6 all even digit numbers and so

$$\frac{6}{100} = .06$$

is an approximation of the probability of having an all boy 4-child family (the exact probability is .0625). Although our approximation is fairly good, in practice one would simulate many more trials to increase the chances that the approximation is close to the true probability.

```
LIST
RNDDIG
10  DIM A$[10]
20  A$="0123456789"
30  FOR A=1 TO 100
40  FOR F=1 TO 4
50  Z=INT(10*RND(8))+1
60  PRINT A$[Z,Z];
70  NEXT F
80  PRINT "    ";
90  NEXT A
100 END
```

(SAMPLE RUN AT BOTTOM OF PAGE)

If it is not important to display the intermediate results then run a program like the one which follows to *simulate* 1000 families (Here 0 = girl, 1 = boy) and determine if a family contains all boys (product of digits will be 1). The only information that is printed is the approximated probability.

```
 10 C = 0                              Start counter
 20 FOR I = 1 TO 1000                  1000 trials
 30 FOR J = 1 TO 4                     4 per family
 40 F(J) = INT (2*RND(8))              Generate 0 or 1
 50 NEXT J
 60 IF F(1)*F(2)*F(3)*F(4)=0 THEN 80  If product 0, then at
                                         least 1 girl. Don't count
 70 C = C+1                            Count number of all
                                       boy families
 80 NEXT I
 90 PRINT  "P(4 BOYS) IS APPROXIMATELY"; C/1000
100 END
```

```
RUN
RNDDIG
0819   7981   0598   3150   5916   3600✓  3729   9761   6806✓  9971   6710   7968
7883   1559   6670   6883   3864   0731   5821   6334   0080✓  7868   8275   7807
9579   3696   0531   5335   7636   4959   5006   4957   0773   0945   2748   8443
7189   3392   3545   3404   2667   2427   1546   0818   3242   5763   8450   7857
1347   1806   9215   3326   4755   1135   4575   8989   0309   6394   3465   9619
9726   1687   5042   0673   4341   7069   4729   2959   6568   4547   6118   3077
6021   3417   9999   1263   5372   9399   8319   8487   9455   2019   5125   8993
2866✓  3752   5297   6324   5962   2534   1671   3751   4805   4605   7660   6488✓
6642✓  9119   2770   5394
```

PROBABILITY con't. . .

Bubblegum Simulation

This particular problem is a good one for computer simulation, for few people know how to calculate the answer directly. Do you?

Here's how we will proceed. Simulate the purchases made by 100 people (Line 50) in the following way:

(1) Initialize a 25-element matrix A to zero to represent the 25 pictures. 0 = picture not purchased; 1 = picture purchased.

(2) Start buying (Line 70). For each purchase, randomly generate an integer Z (Line 80) from 1 to 25 inclusive. Set A(Z,1) = 1 to show that the picture of star Z has been purchased. Check to see if set has been completed (Line 120).

(3) Compute average number of purchases required to complete set.

Here's the program:

```
10  DIM A(25,1),C(1,25),P(1,1),B(100,1),D(1,100)
20  MAT B = ZER
30  MAT C = CON
40  MAT D = CON
50  FOR I = 1 TO 100             100 trials
60  MAT A = ZER
70  FOR J = 1 TO 500             Allow for at most 500 purchases
80  Z = INT (25*RND(8)+1         Generate integers 1 to 25
90  A(Z,1)=1                     Star Z purchased
100 MAT P = C*A                  Product is the sum of the elements of A
110 B(I,1) = B(I,1) + 1
120 IF P(1,1) = 25 THEN 140      If sum is 25 you have entire collection
130 NEXT J
140 NEXT I
150 MAT P = D*B
160 PRINT "EXPECTED NUMBER OF PURCHASES IS ABOUT"; P(1,1)/100
170 END
```

System Reliability

The following program, when run, simulates an experiment to approximate the probability that the system described earlier works for 1000 trials. The program uses these facts:

(1) A system made up of components arranged in series, will work if and only if all components work.

(2) A system made up of components arranged in parallel will work when at least one component works.

```
5   S=0
10  FOR I = 1 TO 500             Try 500 systems
20  FOR J = 1 TO 5               5 components
30  C(J) = INT(10*RND(8))+1      Integer between 1 and 10 inclusive
40  IF C(J)>6 THEN 70            If C(J)=7,8,9, or 10, then C(J) fails
50  C(J) = 1                     Replace C(J) by 1 to mean it works
60  GO TO 80
70  C(J) = 0                     Replace C(J) by 0 to mean it fails
80  NEXT J
90  IF C(1)=1 or C(2)=1 or C(3)=1 THEN 110  Does subsystem A work?
100 GO TO 140
110 IF C(4)=1 or C(5)=1 THEN 130            Does subsystem B work?
120 GO TO 140
130 S = S+1                                  If both work, count as a success
140 NEXT I
150 PRINT "RELIABILITY ABOUT" S/500
160 END
```

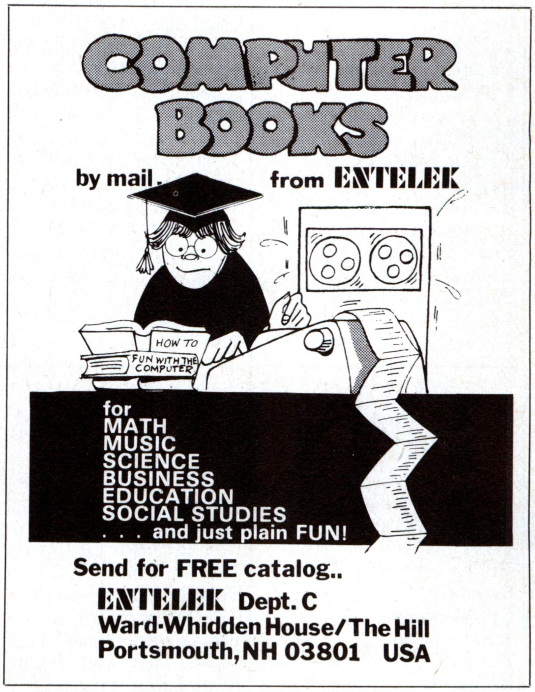
The reader should note that there are other ways to accomplish the test above. For example, lines 90-130 could be replaced with

```
90  IF (C(1) + C(2) + C(3)) * (C(4) + C(5)) = 0 THEN 110
100 S = S+1
110 NEXT I
```

CONCLUSIONS

The three examples presented in this paper illustrate how computer simulations can be used to "problem-solve" in probability.

Teachers need not delay the study of probability just because their students lack theory. The foundation of probability is experiments and young children can be introduced to questions about chance events and can conduct experiments to suggest answers. Upper elementary school children can study coins, dice, cards, and other objects by actually experimenting with them. As the children get older and the experiments become more complex, simulations become a welcomed relief. Introduce simulations gently and with much practice so that the concept is understood. One approach is to devise simulations using tables of random numbers and then lead to the computer when appropriate. Good luck. ■



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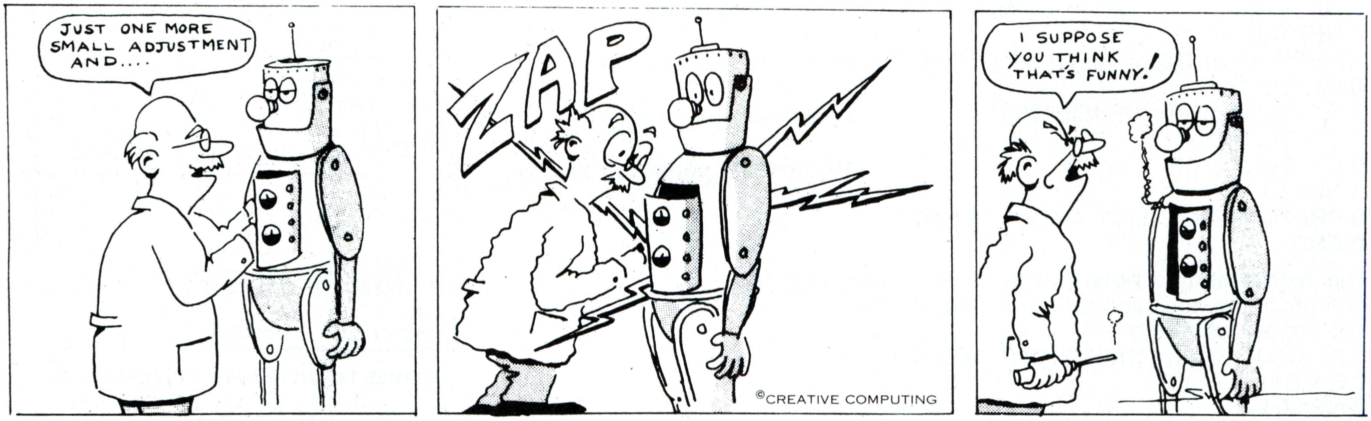
Curricula	Author	Title	Publisher	Date	Pages	Type			Style		
						Text	Ref.	Hdbk.	P.I.	Case	Norm.
· Computer Applications	Business Games										
	Barton	A Primer on Simulation and Gaming	P-H	1970	239		X				X
	Belch	Contemporary Games Vol. I Directory	Gale	1973	560		X				G
	Belch	Contemporary Games Vol. II Bibliography	Gale	1974	408		X				G
	Coppard, Goodman, ed	Urban Gaming/Simulation '77	Michigan	1977	376		X				G
	Duke	Gaming: The Future's Language	Sage	1974	223		X				X
	Frazer	Business Decision Simulation: A T/S Approach	Reston	1975	160		X				G
	Frazer	Introduction to Business Simulation	Reston	1977	131		X				X
	Gibbs	Handbook of Games and Simulation Exercises	Sage	1974	226		X				X
	Greenbalt, Duke	Gaming Simulation: Rationale, Design&Applic.	Halsted	1975	435		X				G
	Henshaw, Jackson	The Executive Game	Irwin	1972	161		X				G
	Inbar, Stoll	Simulation and Gaming in Social Science	FreePress	1972	313		X				R
	Jensen,	The Business Management Laboratory	B.P.I.	1973	87		X				G
	Jensen, Cherrington	Manual for the Business Management Lab	B.P.I.	1977	200		X				G
	Maidment, Bronstein	Simulation Games: Design, Implementation	Merrill	1973	99		X				X
	McFarlan, et al	The Management Game	Macmillan	1970	153		X				G
	Scott, Strickland	Tempomatic IV: A Management Simulation	Houghton	1974	77		X				G
	Smith, et al	Integrated Simulation	South-W	1974	56		X				G
	Smith	Simulating Gaming	C.D.C.	1973	128		X				P
	Zuckerman, Horn	The Guide to Simulation Games	Info.Res.	1970	334			X			X
	Simulation Techn.										
	Alfeld, Graham	Introduction to Urban Dynamics	W-A	1976	340		X				X
	Birtwhistle, et al	SIMULA Begin	Auerbach	1973	391	X					X
	Bobillier, et al	Simulation With GPSS and GPSS V	P-H	1976	495		X				X
	Chen, Kaczka	Operations & Sys. Anal.: A Simulation Appr.	A-Bacon	1974	452		X				X
	Colella, et al	Systems Simulation: Methods & Applications	D.C.Heath	1974	290		X				X
	Forrester	Collected Papers of Jay W. Forrester	W-A	1975	284		X				X
	Franta	The Process View of Simulation	Elsevier	1977	244		X				X
	Gordon	The Applic. of GPSS V to Discrete System Sim.	P-H	1975	389	X					X
	Greenberg	GPSS Primer	Wiley	1972	324		X				X
	House, ed.	Business Simulation for Decision Making	Petrocell	1977	364		X				R
	Lewis	Distribution Sampling for Computer Simulation	Lexington	1975	150		X				X
	Mass	Readings in Urban Dynamics: Vol. 1	W-A	1974	303		X				R
	Moore, Clayton	GERT Modeling and Simulation	Petrocell	1976	230	X					X
	Padulo, Arbib	System Theory--Cont., Discrete Systems	Saunders	1974	779		X				X
	Poole, et al	Using Simulation to Solve Problems	M-H	1977	333	X					X
	Pritsker, Young	Simulation With GASP-PL/1	Wiley	1975	335	X					X
	Scalzo, Hughes	Elementary Computer-Assisted Statistics	Petrocell	1976	345	X					X
	Schriber	Simulation Using GPSS	Wiley	1974	533	X					X
	Shannon	Systems Simulation: The Art and Science	P-H	1975	387		X				X
	Speckhart, Green	A Guide to Using CSMP	P-H	1976	325	X					X
	Zeigler	Theory of Modeling and Simulation	Wiley	1976	435	X					X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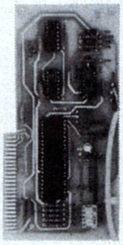
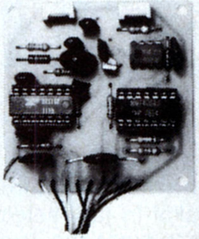


Part no. 2
Baud rate is continuously adjustable from 0 to 30,000 • Plugs into any peripheral connector • Low current drain. RS-232 input and output • On board switch selectable 5 to 8 data bits, 1 or 2 stop bits, and parity or no parity either odd or even • Jumper selectable address • SOFTWARE • Input and Output routine from monitor or BASIC to teletype or other serial printer. • Program for using an Apple II for a video or an intelligent terminal. Also can output in correspondence code to interface with some selectrics. Board only — $15.00; with parts — $42.00; assembled and tested — $62.00.

MODEM *

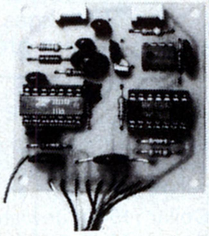


Part no. 109
• Type 103 • Full or half duplex • Works up to 300 baud • Originate or Answer • No coils, only low cost components • TTL input and output-serial • Connect 8 ohm speaker and crystal mic. directly to board • Uses XR FSK demodulator • Requires +5 volts • Board $7.60; with parts $27.50

DC POWER SUPPLY *

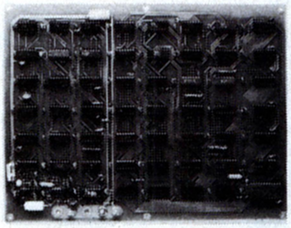
Part no. 6085
• Board supplies a regulated +5 volts at 3 amps., +12, -12, and -5 volts at 1 amp. • Power required is 8 volts AC at 3 amps., and 24 volts AC C.T. at 1.5 amps. • Board only $12.50; with parts excluding transformers $42.50

TAPE INTERFACE *



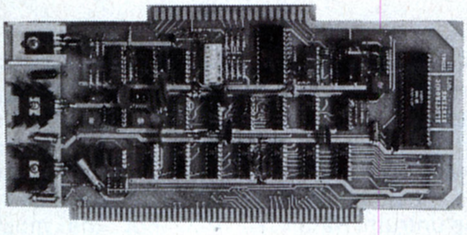
Part no. 111
• Play and record Kansas City Standard tapes • Converts a low cost tape recorder to a digital recorder • Works up to 1200 baud • Digital in and out are TTL-serial • Output of board connects to mic. in of recorder • Earphone of recorder connects to input on board • No coils • Requires +5 volts, low power drain • Board $7.60; with parts $27.50

T.V. TYPEWRITER



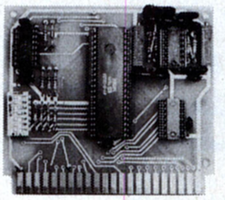
Part no. 106
• Stand alone TVT • 32 char/line, 16 lines, modifications for 64 char/line included • Parallel ASCII (TTL) input • Video output • 1K on board memory • Output for computer controlled curser • Auto scroll • Non-destructive curser • Curser inputs: up, down, left, right, home, EOL, EOS • Scroll up, down • Requires +5 volts at 1.5 amps, and -12 volts at 30 mA • All 7400, TTL chips • Char. gen. 2513 • Upper case only • Board only $39.00; with parts $145.00

TIDMA *



Part no. 112
• Tape Interface Direct Memory Access • Record and play programs without bootstrap loader (no prom) has FSK encoder/decoder for direct connections to low cost recorder at 1200 baud rate, and direct connections for inputs and outputs to a digital recorder at any baud rate. • S-100 bus compatible • Board only $35.00; with parts $110.00

UART & BAUD RATE GENERATOR *



Part no. 101
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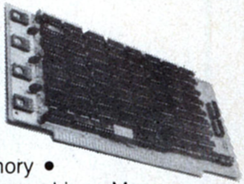
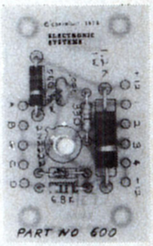


Part no. 300
• 8K Altair bus memory • Uses 2102 Static memory chips • Memory protect • Gold contacts • Wait states • On board regulator • S-100 bus compatible • Vector input option • TRI state buffered • Board only $22.50; with parts $160.00

RF MODULATOR *

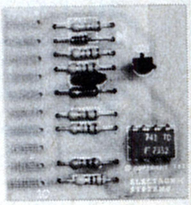
Part no. 107
• Converts video to AM modulated RF, Channels 2 or 3. So powerful almost no tuning is required. On board regulated power supply makes this extremely stable. Rated very highly in Doctor Dobbs' Journal. Recommended by Apple. • Power required is 12 volts AC C.T., or +5 volts DC • Board $7.60; with parts $13.50

RS 232/TTY * INTERFACE



Part no. 600
• Converts RS-232 to 20mA current loop, and 20mA current loop to RS-232 • Two separate circuits • Requires +12 and -12 volts • Board only $4.50, with parts $7.00

RS 232/TTL* INTERFACE



Part no. 232
• Converts TTL to RS-232, and converts RS-232 to TTL • Two separate circuits • Requires -12 and +12 volts • All connections go to a 10 pin gold plated edge connector • Board only $4.50; with parts $7.00 with connector add $2.00

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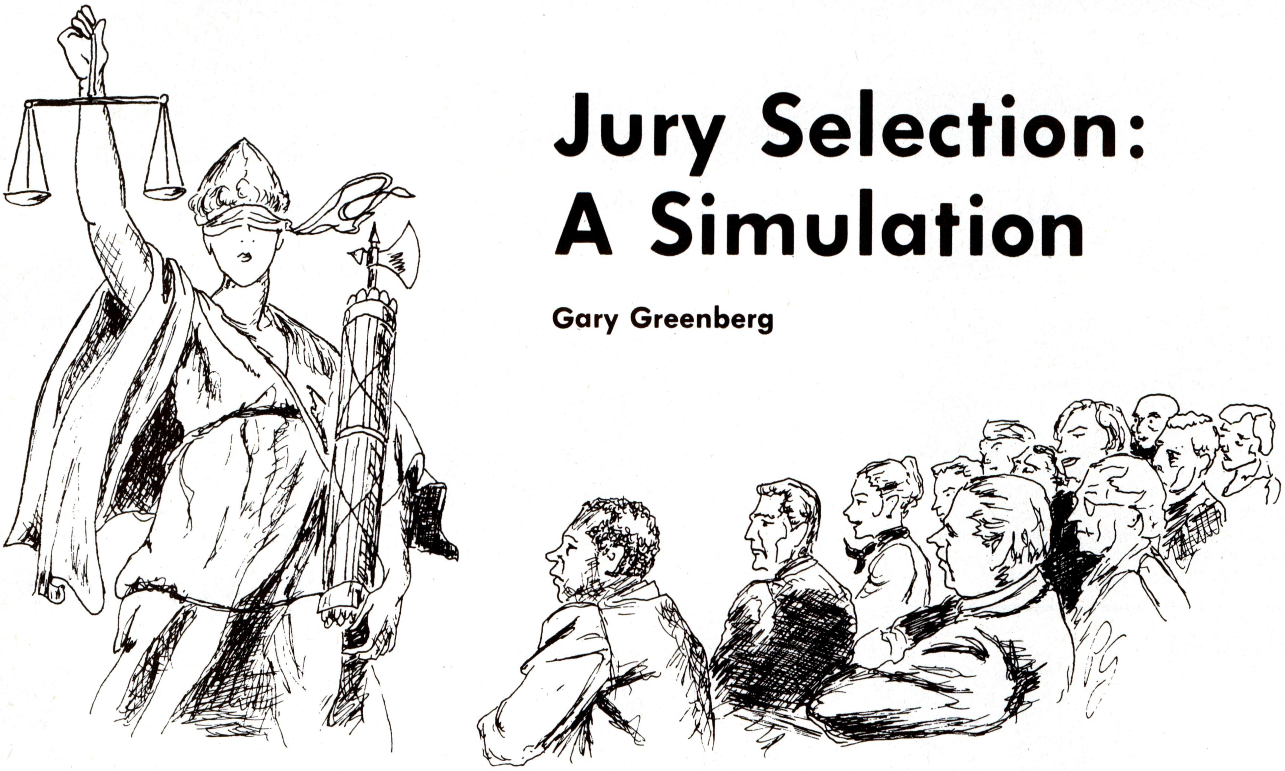

Jury Selection: A Simulation

Gary Greenberg

Most people get their picture of the criminal justice system from television, which is like studying public schools by watching "Welcome Back Kotter."

No criminal trial gets resolved during a commercial break. And I have yet to meet a lawyer who claims to have seen a witness break down on the stand and admit he was caught lying, no matter how obvious the untruth. Rarely is a surprise witness brought in at the last minute to explode the whole case.

In fact, the average criminal trial is a slow, plodding adventure. Most cases fall into a routine pattern consisting of one or two essential witnesses. In the robbery case, the issue is the victim's memory of the perpetrator's appearance. In the burglary or drug case, the issue is usually the credibility of the police officer's testimony. Very few other kinds of cases go to trial.

The prosecutor will usually challenge all nonwhite minorities, young people, and people in social-service work or involved in arty or radical causes.

In New York City, where most of my observations take place, at least 90% of the defendants are black or hispanic. Over 70% of the jurors are white. A small percentage of the more than 500,000 arrests ever reach a trial stage. Almost everything is disposed of through plea bargaining.

But there are cases that do go to trial. And in such situations the selection of the jury is a key procedure. Though jurors are always told that a defendant is innocent until proven guilty, the defense attorney acts on the assumption that the juror believes the defendant is guilty until proven innocent.

Additionally, when probing into the biases and prejudices of a juror, the defense attorney rarely accepts the juror's word. The skill in jury selection usually revolves around the attempt to place the juror in a social category and play the percentages. Little nuances in the way the juror answers also play a role.

For the most part, the defense attorney and the prosecutor make broad assumptions and look for the exceptions. The prosecutor will usually challenge all nonwhite minorities, young people, and people in social-service work or involved in arty or radical causes. The defense attorney will usually challenge white ethnics, older people and government employees. Of course there are exceptions. If you have a police defendant, the defense and prosecution might reverse polarity in their choices. Similarly, for example, if you have a black victim and a white defendant. Crass as it sounds, this is the way jury selection is frequently conducted.

However, there is a big kicker. Each side is only allowed a certain number of challenges without having to state a reason. In New York, on a robbery or burglary in the first degree, you get 15 such challenges. This greatly handicaps the defense in that there are substantially more

SEX	JOB	RACE	AGE
Male (50-0)	Professional (10-5)	Wasp (25-7)	20 (10-5)
Female (50-2)	Civil Service (15-8)	Irish (15-10)	30 (20-8)
	Blue Collar (30-7)	Italian (10-12)	40 (20-10)
	White Collar (15-6)	Jewish (5-11)	50 (25-12)
	Unemployed (10-3)	Nordic (10-13)	60 (25-15)
	Retired (20-10)	Black (20-3)	
		Slavic (10-15)	
		Hispanic (5-5)	

Fig. 1. This figure shows the percentage and point distributions for each category. The first number in the parenthesis is the percentage of the category allotted to that member of the category. The second number indicates how many points are allotted for that member of the category; that is, Irish constitute 15% of the racial category and add 10 points to the jury member's total.

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unsatisfactory jurors in the pool from the defense point of view than from the prosecution point of view. That is, there are a lot more older white ethnics than there are young blacks. The defense attorney approaches jury selection, never expecting a sympathetic jury, but merely trying to minimize the bias against the client. And once he has used up his challenges the attorney is stuck with whoever is subsequently selected, unless the judge can be convinced that the jury is inherently biased against the defense, a difficult task to be sure.

Figure 1 is an outline of the model for the jury selection. There are four major categories: age, sex, race and job. Each element in each category is assigned a probable percentage and a probable anti-defendant bias factor. The program presents a bias in favor of conviction. The challenge is to minimize that bias.

You will be given ten challenges. After each round of displaying the potential jurors' characteristics, you will be asked to make any challenges. If you do not challenge a juror during the round in which he is placed in the jury box, you will not be able to reconsider later. On each round you will only be shown those new jurors that are up for consideration. Once you are out of challenges you will be stuck with whatever jurors the computer picks to complete the twelve-person jury. After the jury is completed, you will be shown the completed jury and the characteristics for your study. Then you will be shown the first ballot vote and the final verdict.

Statistics at best give a guideline for guessing, but guarantee nothing about any specific individual.

At this time, when many people are sensitive to group slanders or slurs, I think a few cautionary notes are in order. The allotment of bias points should in no way be used to believe I have a positive or negative view of any particular group in this study. And yes, of course, in no way can one determine what any specific member of a group would do, given a statistical sample about that group. Statistics at best give a guideline for guessing, but guarantee nothing about any specific individual. The assignment of zero bias points to males does not mean that men are not antidefendant and that women are. It means that, I had to have some point which was ground zero because, the program is based on a cumulative scale.

In the model, sex is the least significant factor involved in the jury-selection criteria. However it is believed by many attorneys that females on average are likely to exhibit a slight more bias than a male towards a criminal defendant. Therefore zero points were assigned to the male and two points to the female. These are the two lowest assigned bias points in the model.

How The Program Works

I have set up three arrays. The A$(3,8) array contains the string names for race, job, and sex. The N(12,6) array contains the numeric description of the elements in each category for each juror. The M(12,6) array contains the bias points for each element for each juror. The M and N arrays can be redimensioned to (12,5) since the extra column was just left over from my experimenting with additional characteristics.

With (I) standing for the Ith juror, N(I,2) is equal to either 20,30,40,50 or 60 and gives the age of the Ith juror. N(I,3) equals 1 or 2 and gives the sex of the Ith juror. N(I,4) is an integer from 1 to 8 and represents the race of the Ith juror. And similarly N(I,5) represents the job classification.

Thus: A$ (1,N(I,3)) gives the Ith juror's sex.
A$(2,N(I,5)) gives the Ith juror's job.
A$(3,N(I,4)) gives the 1th juror's race.
N(I,2) gives the Ith juror's age.

The M array from (I,2)(I,5) correspond element for element with the N array with each element of M containing the bias points for each corresponding element of N. M(I,1) contains the sum of M(I,2)-M(I,5).

Lines 430-470: selects jurors for consideration. Line 440 checks the value of N(I,1). N(I,1) is the selection status for each juror seat. IF N(I,1)=0 then the seat is vacant and has to be filled, in which case the program branches to subroutine 2030 to select the juror's characteristics for the potential new juror.

Lines 515-615: This is the portion of the program that makes sure the proper challenges are made, and records the challenges.

Line 690: Tests to see if jury is complete.

Line 700: Checks to see if any challenges left.

Line 710: Sends you back for additional round of challenges if the jury is incomplete and you have challenges left.

Lines 770-790: Selects the remaining jurors when jury is incomplete and challenges are exhausted.

Lines 1070-1140: Prints out the first ballot.

Lines 1050: Generates the verdict testing number. To increase the chances of acquittal, reduce the multiplier of RND(1). To increase the chance of a conviction, raise the multiplier.

Lines 1150-1230: Determine final verdict.

Lines 2030-2410: This is the subroutine that selects the characteristics of each juror. Each element in each category is independently determined, with one exception. If the juror is determined to be retired (line 2270) then the age is set at 60 (line 2280).

Line 90: To increase the number of challenges, increase K.

Dialect Notes

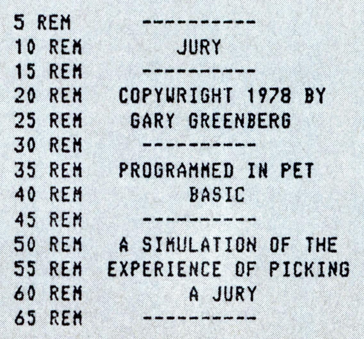
This program is written in PET basic and is esthetically designed for a 40-character-width screen. The language should be compatible with at least Altair and OSI basic and should be easily convertible to other Basics.

In PET Basic a ? can be used instead of the instruction PRINT. In line 3000, I used the statement ?"CLR". This clears the screen and is done on the PET by holding the SHIFT and CLR at the same time. On the PET, this will be displayed as a heart on a reverse field. It is not necessary for the program to use that instruction if it is not available to you. If omitted make sure to eliminate all references to GOSUB 3000.

PET Basic does not require the RANDOMIZE statement. IF your version does, make sure to include it.

Finally, the program takes up about 4200 bytes with instructions and about 3200 bytes without the instructions. ■

Jury Program Listing



```
5 REM      ----------
10 REM        JURY
15 REM     ----------
20 REM   COPYWRIGHT 1978 BY
25 REM    GARY GREENBERG
30 REM     ----------
35 REM   PROGRAMMED IN PET
40 REM        BASIC
45 REM     ----------
50 REM   A SIMULATION OF THE
55 REM  EXPERIENCE OF PICKING
60 REM        A JURY
65 REM     ----------
```

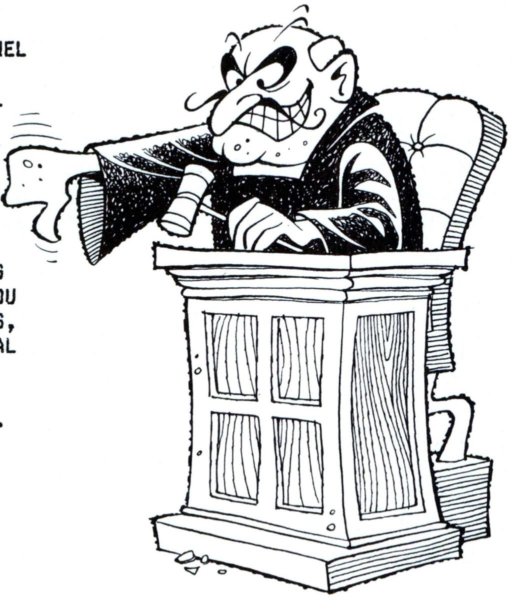
Jury Listing cont'd ....

```
80 DIM N(12,6),M(12,6),A$(3,8)
90 K=10:S=0:E=0:T=0
100 A$(1,1)="MALE":A$(1,2)="FEMALE"
110 A$(2,1)="PROFESSIONAL":A$(2,2)="CIVIL SERVICE"
120 A$(2,3)="BLUE COLLAR":A$(2,4)="WHITE COLLAR"
130 A$(2,5)="UNEMPLOYED":A$(2,6)="RETIRED"
140 A$(3,1)="WASP":A$(3,2)="IRISH"
150 A$(3,3)="ITALIAN":A$(3,4)="JEWISH"
160 A$(3,5)="NORDIC":A$(3,6)="BLACK"
170 A$(3,7)="SLAVIC":A$(3,8)="HISPANIC"
180 FOR I=1 TO 12:FOR J=1 TO 6
190 N(I,J)=0:M(I,J)=0
200 NEXT J:NEXT I
210 GOSUB 3000:GOSUB 3200
220 PRINT TAB(18);"JURY"
230 PRINT TAB(19);"BY"
240 PRINT TAB(12);"GARY GREENBERG"
250 GOSUB 3200
260 PRINT:PRINT:PRINT:PRINT TAB(2);
270 INPUT " DO YOU WANT INSTRUCTIONS (Y OR N)";Q$
280 IF LEFT$(Q$,1) <> "Y" GOTO 420
290 GOSUB 3000:PRINT TAB(13);"INSTRUCTIONS"
300 PRINT TAB(13);"------------"
310 PRINT "YOU WILL BE SHOWN A PANEL OF POTENTIAL"
315 PRINT "JURORS ALONG WITH SOME BACKGROUND DATA.":PRINT
320 PRINT "THE DATA REFLECTS FACTS THAT MANY"
325 PRINT "ATTORNEYS THINK WILL AFFECT A JUROR'S"
330 PRINT "FINAL VERDICT. AFTER EXAMINING THE PANEL"
335 PRINT "YOU WILL BE ASKED HOW MANY CHALLENGES"
340 PRINT "YOU WISH TO USE. YOU WILL HAVE A TOTAL"
350 PRINT "OF 10. YOU WILL BE ASKED WHICH JURORS"
355 PRINT "YOU ARE GOING TO CHALLENGE.":PRINT
360 PRINT "ANY JUROR NOT CHALLENGED WILL"
365 PRINT "BE SEATED AND MAY NOT BE CHALLENGED"
370 PRINT "LATER. IF YOU EXHAUST YOUR CHALLENGES"
375 PRINT "THE COMPUTER WILL SELECT THE REMAINING"
385 PRINT "JURORS. WHEN THE JURY IS COMPLETED, YOU"
390 PRINT "WILL GET A LISTING OF THE JURY MEMBERS,"
395 PRINT "THEIR DATA, THEIR FIRST VOTE, THE FINAL"
400 PRINT "COLLECTIVE VERDICT.":PRINT
405 PRINT "THE DATA IS BASED ON A CRIMINAL TRIAL."
410 GOSUB 3400
420 GOSUB 3000:PRINT:GOSUB 3100
430 FOR I=1 TO 12
440 IF N(I,1) <> 0 GOTO 470
450 GOSUB 2030
460 GOSUB 3300
470 NEXT I
510 GOSUB 3200
515 PRINT "YOU HAVE";K;" CHALLENGES LEFT."
520 INPUT "HOW MANY CHALLENGES";C:C=INT(C)
525 IF C>12-T GOTO 510
530 IF C>K GOTO 510
540 IF C<1 GOTO 590
542 K=K-C
545 FOR J=1 TO C
550 PRINT "CHALLENGE #";J;:INPUT Y
552 IF Y<1 GOTO 550
554 IF Y>12 GOTO 550
555 IF N(Y,1) <> 0 GOTO 550
560 N(Y,1)=2:NEXT J
590 FOR I=1 TO 12:IF N(I,1) <> 2 THEN N(I,1)=1
595 NEXT I
600 FOR I=1 TO 12:IF N(I,1)=2 THEN N(I,1)=0
605 NEXT I
610 FOR I=1 TO 12:IF N(I,1)=0 THEN E=E+1
615 NEXT I
620 T=12-E
625 PRINT "YOU HAVE SEATED";T;" JURORS"
630 GOSUB 3400
690 IF T=12 GOTO 900
700 IF K=0 GOTO 720
710 E=0:GOTO 420
720 GOSUB 3000
730 FOR I=1 TO 6:PRINT:NEXT I:GOSUB 3200
740 PRINT TAB(6);"YOU ARE OUT OF CHALLENGES."
750 PRINT " YOU GET THE NEXT";12-T;"JURORS IN THE BOX."
760 PRINT TAB(13);"HERE THEY ARE.":GOSUB 3200:GOSUB 3100
770 FOR I=1 TO 12: IF N(I,1) <> 0 GOTO 790
780 GOSUB 2030:GOSUB 3300
790 NEXT I
800 GOSUB 3200:GOSUB 3400
900 GOSUB 3000:GOSUB 3200
910 PRINT TAB(6);"THE JURY IS NOW COMPLETE."
920 PRINT TAB(6);"HERE IS THE FINAL SEATING."
930 GOSUB 3200:GOSUB 3100
940 FOR I=1 TO 12:GOSUB 3300:NEXT I
950 GOSUB 3200:GOSUB 3400
1050 R1=5+56*RND(1)
1055 GOSUB 3000:GOSUB 3200
1060 PRINT:PRINT TAB(14);"FIRST BALLOT"
1065 GOSUB 3200
1070 FOR I=1 TO 12
1080 M(I,1)=M(I,2)+M(I,3)+M(I,4)+M(I,5)
1090 M=M(I,1)
1100 PRINT TAB(9);"JUROR #";:IF I<10 THEN PRINT TAB(17);
1105 PRINT I
1110 IF M<R1 GOTO 1130
1120 PRINT"GUILTY!":GOTO 1140
1130 PRINT "NOT GUILTY!"
1140 M=0:NEXT I:GOSUB 3200
1150 V=0:FOR I=1 TO 12:V=V+M(I,1):NEXT I
1190 V1=V/12:IF V1<R1 GOTO 1230
1210 PRINT:PRINT:PRINT "FINAL VERDICT: GUILTY!":GOTO 2600
1220 IF Z2=0 THEN 1240
1230 PRINT "FINAL VERDICT: NOT GUILTY!":GOTO 2600
2030 R=100*RND(1)
2040 N(I,2)=20:M(I,2)=5
2050 IF R>10 THEN N(I,2)=30:M(I,2)=8
2060 IF R>30 THEN N(I,2)=40:M(I,2)=10
2070 IF R>50 THEN N(I,2)=50:M(I,2)=12
2080 IF R>75 THEN N(I,2)=60:M(I,2)=15
2140 N(I,3)=1:R=RND(1)
2150 IF R>.5 THEN N(I,3)=2:M(I,3)=2
2220 N(I,4)=1:M(I,4)=5:R=RND(1)*100
2230 IF R>10 THEN N(I,4)=2:M(I,4)=8
2240 IF R>25 THEN N(I,4)=3:M(I,4)=7
2250 IF R>55 THEN N(I,4)=4:M(I,4)=6
2260 IF R>70 THEN N(I,4)=5:M(I,4)=3
2270 IF R>80 THEN N(I,4)=6:M(I,4)=10
2280 IF R>80 THEN N(I,2)=60:M(I,2)=15
2320 N(I,5)=1:M(I,5)=7:R=RND(1)*100
2340 IF R>25 THEN N(I,5)=2:M(I,5)=10
2350 IF R>40 THEN N(I,5)=3:M(I,5)=12
2360 IF R>50 THEN N(I,5)=4:M(I,5)=11
2370 IF R>55 THEN N(I,5)=5:M(I,5)=13
2380 IF R>65 THEN N(I,5)=6:M(I,5)=3
2390 IF R>85 THEN N(I,5)=7:M(I,5)=15
2400 IF R>95 THEN N(I,5)=8:M(I,5)=5
2410 RETURN
2600 INPUT "DO YOU WANT TO TRY ANOTHER CASE";Z$
2610 IF LEFT$(Z$,1)="Y" GOTO 90
2630 PRINT:PRINT "THERE BEING NO FURTHER BUSINESS BEFORE"
2640 PRINT "THE COURT, WE STAND IN RECESS."
2650 GOTO 9999
3000 PRINT "CLR":RETURN
3100 PRINT TAB(14);"JURY PANEL"
3110 PRINT TAB(14);"----------"
3120 PRINT "  #  SEX      AGE  RACE       JOB"
3130 GOSUB 3200
3140 RETURN
3200 FOR J=1 TO 39:PRINT "-";:NEXT J:PRINT
3210 RETURN
3300 IF I<10 THEN PRINT TAB(1);
3305 PRINT I;TAB(4);":";A$(1,N(I,3));
3310 PRINT TAB(12);N(I,2);TAB(17);A$(3,N(I,5));
3320 PRINT TAB(26);A$(2,N(I,4)):RETURN
3400 PRINT TAB(10);
3410 INPUT "HIT 'RETURN' TO CONTINUE";Q$:RETURN
9999 END
```

Sample Run

```
RUN
CLR
----------------------------------------
                  JURY
                   BY
             GARY GREENBERG
----------------------------------------



   DO YOU WANT INSTRUCTIONS (Y OR N)? Y
CLR
              INSTRUCTIONS
              ------------
YOU WILL BE SHOWN A PANEL OF POTENTIAL
JURORS ALONG WITH SOME BACKGROUND DATA.

THE DATA REFLECTS FACTS THAT MANY
ATTORNEYS THINK WILL AFFECT A JUROR'S
FINAL VERDICT. AFTER EXAMINING THE PANEL
YOU WILL BE ASKED HOW MANY CHALLENGES
YOU WISH TO USE. YOU WILL HAVE A TOTAL
OF 10. YOU WILL BE ASKED WHICH JURORS
YOU ARE GOING TO CHALLENGE.

ANY JUROR NOT CHALLENGED WILL
BE SEATED AND MAY NOT BE CHALLENGED
LATER. IF YOU EXHAUST YOUR CHALLENGES
THE COMPUTER WILL SELECT THE REMAINING
JURORS. WHEN THE JURY IS COMPLETED, YOU
WILL GET A LISTING OF THE JURY MEMBERS,
THEIR DATA, THEIR FIRST VOTE, THE FINAL
COLLECTIVE VERDICT.

THE DATA IS BASED ON A CRIMINAL TRIAL.
          HIT 'RETURN' TO CONTINUE?
CLR



              JURY PANEL
              ----------
 #  SEX       AGE  RACE          JOB
----------------------------------------
 1 :MALE     30   NORDIC     WHITE COLLAR
 2 :MALE     50   BLACK      PROFESSIONAL
 3 :MALE     60   BLACK      UNEMPLOYED
 4 :MALE     60   BLACK      CIVIL SERVICE
 5 :MALE     50   NORDIC     BLUE COLLAR
 6 :MALE     60   SLAVIC     BLUE COLLAR
 7 :FEMALE   60   SLAVIC     BLUE COLLAR
 8 :MALE     30   BLACK      BLUE COLLAR
 9 :FEMALE   30   NORDIC     UNEMPLOYED
10 :MALE     40   BLACK      UNEMPLOYED
11 :MALE     60   WASP       UNEMPLOYED
12 :FEMALE   60   JEWISH     RETIRED
----------------------------------------
YOU HAVE 10  CHALLENGES LEFT.
HOW MANY CHALLENGES? 5
CHALLENGE # 1 ? 1
CHALLENGE # 2 ? 6
CHALLENGE # 3 ? 7
CHALLENGE # 4 ? 11
CHALLENGE # 5 ? 12
YOU HAVE SEATED 7  JURORS
          HIT 'RETURN' TO CONTINUE?
CLR
```

```
              JURY PANEL
              ----------
 #  SEX       AGE  RACE          JOB
----------------------------------------
 1 :FEMALE   60   BLACK      RETIRED
 6 :FEMALE   60   IRISH      CIVIL SERVICE
 7 :FEMALE   50   JEWISH     BLUE COLLAR
11 :MALE     60   IRISH      RETIRED
12 :MALE     60   NORDIC     BLUE COLLAR
----------------------------------------
YOU HAVE 5  CHALLENGES LEFT.
HOW MANY CHALLENGES? 2
CHALLENGE # 1 ? 6
CHALLENGE # 2 ? 7
YOU HAVE SEATED 10  JURORS
          HIT 'RETURN' TO CONTINUE?
CLR
```



```
              JURY PANEL
              ----------
 #  SEX       AGE  RACE          JOB
----------------------------------------
 6 :FEMALE   50   IRISH      WHITE COLLAR
 7 :MALE     60   BLACK      CIVIL SERVICE
----------------------------------------
YOU HAVE 3  CHALLENGES LEFT.
HOW MANY CHALLENGES? 2
CHALLENGE # 1 ? 6
CHALLENGE # 2 ? 7
YOU HAVE SEATED 10  JURORS
          HIT 'RETURN' TO CONTINUE?
CLR

              JURY PANEL
              ----------
 #  SEX       AGE  RACE          JOB
----------------------------------------
 6 :MALE     30   ITALIAN    UNEMPLOYED
 7 :MALE     60   SLAVIC     RETIRED
----------------------------------------
YOU HAVE 1  CHALLENGES LEFT.
HOW MANY CHALLENGES? 1
CHALLENGE # 1 ? 7
YOU HAVE SEATED 11  JURORS
          HIT 'RETURN' TO CONTINUE?
CLR
```

```
----------------------------------------
     YOU ARE OUT OF CHALLENGES.
 YOU GET THE NEXT 1 JURORS IN THE BOX.
            HERE THEY ARE.
----------------------------------------
              JURY PANEL
              ----------
 #  SEX       AGE  RACE          JOB
----------------------------------------
 7 :MALE     60   WASP       RETIRED
----------------------------------------
          HIT 'RETURN' TO CONTINUE?
CLR
----------------------------------------
      THE JURY IS NOW COMPLETE.
      HERE IS THE FINAL SEATING.
----------------------------------------
              JURY PANEL
              ----------
 #  SEX       AGE  RACE          JOB
----------------------------------------

 1 :FEMALE   60   BLACK      RETIRED
 2 :MALE     50   BLACK      PROFESSIONAL
 3 :MALE     60   BLACK      UNEMPLOYED
 4 :MALE     60   BLACK      CIVIL SERVICE
 5 :MALE     50   NORDIC     BLUE COLLAR
 6 :MALE     30   ITALIAN    UNEMPLOYED
 7 :MALE     60   WASP       RETIRED
 8 :MALE     30   BLACK      BLUE COLLAR
 9 :FEMALE   30   NORDIC     UNEMPLOYED
10 :MALE     40   BLACK      UNEMPLOYED
11 :MALE     60   IRISH      RETIRED
12 :MALE     60   NORDIC     BLUE COLLAR
----------------------------------------
          HIT 'RETURN' TO CONTINUE?
CLR
----------------------------------------

             FIRST BALLOT
----------------------------------------
          JUROR #  1
NOT GUILTY!
          JUROR #  2
NOT GUILTY!
          JUROR #  3
NOT GUILTY!
          JUROR #  4
NOT GUILTY!
          JUROR #  5
NOT GUILTY!
          JUROR #  6
NOT GUILTY!
          JUROR #  7
NOT GUILTY!
          JUROR #  8
NOT GUILTY!
          JUROR #  9
NOT GUILTY!
          JUROR # 10
NOT GUILTY!
          JUROR # 11
NOT GUILTY!
          JUROR # 12
NOT GUILTY!
----------------------------------------
FINAL VERDICT: NOT GUILTY!
DO YOU WANT TO TRY ANOTHER CASE? N

THERE BEING NO FURTHER BUSINESS BEFORE
THE COURT, WE STAND IN RECESS.
OK
```

Charles Staelin at Amherst introduces students to tough management decisions via a simulation game.

Real World Games

by Robert D. Chadbourne

I am by nature a pack rat; I seldom throw anything out except under great duress, or until it has gathered dust for at least 10 years. Well, it was just a year or so ago that I finally tossed out my files and notes from graduate school. And then this article arrived last week. What's the connection? Read on.

This article is about one of the most incredibly complete and sophisticated simulations of the consumer packaged-goods industry, consisting of a number of competitive business firms complete to the last detail. This type of simulation is commonly called a management game; this particular one is the grandaddy of many subsequent offspring games. It was originally conceived and written at the Graduate School of Industrial Administration at Carnegie-Mellon University in the late '50s and early '60s. It was written for the Bendix G-15 (and G-20) computer in a language called GATE. Some wise person decided in 1961 that GATE wasn't a very transportable language and it really shouldbe in FORTRAN. Further it was decided that some graduate student who (1) was on a work fellowship and thus owed his life to the school and (2) who was bilingual in those two languages, should do the translation. And guess who got the job....

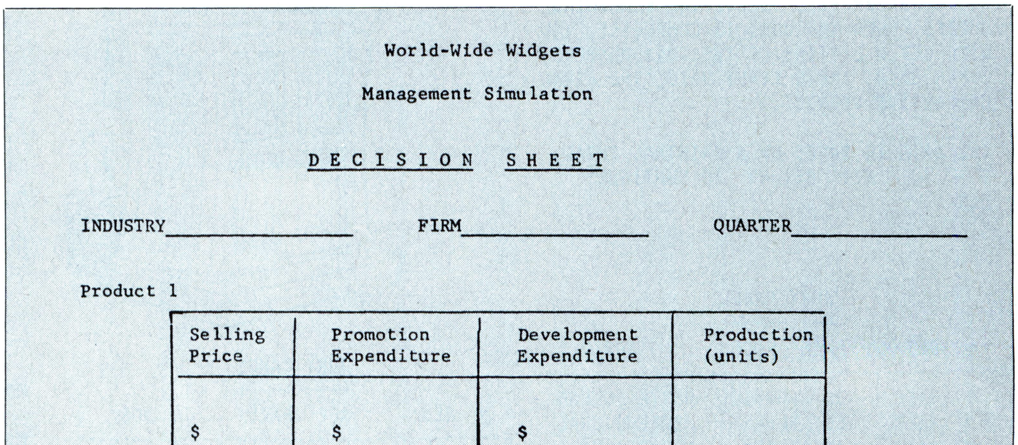
And guess which hundreds of flowcharts and thousands of pages of sample runs and side-by-side listings I just threw away. To most readers today, GATE would look like an obscure Welsh dialect and even Fortran II looks pitifully archaic. But it's all gone now, although the "game"itself lives on!
—DHA

Sales forecasting, model building, production scheduling, profit analysis and cash flow. The corporate level decision making usually made by the man with a title on the door and some gray at the temples. So who in the name of sanity would ever turn over that kind of authority to a bunch of nineteen and twenty year olds?

Charles P. Staelin, Associate Professor of Economics at Amherst College for one. Staelin's thirty Junior Economics majors have been cast into leadership roles in phantom multi-million dollar corporations in a game known as a management simulation exercise developed by the Graduate School of Industrial Administration at Carnegie Mellon University in Pittsburgh.

Staelin, an affable bearded young man of 32 had heard it all before like every other prof. "Why do I have to learn this?" "Why aren't you getting us ready for the Real World?" And the new modern version of complaint reaching faculty ears these days: "How is this relevant?"

There's not much more of that talk being heard at Amherst. Staelin, a Riverside, Connecticut native who joined the Amherst faculty three years ago after completing all his Economics schooling through the doctorate level



World-Wide Widgets

Management Simulation

DECISION SHEET

INDUSTRY________ FIRM________ QUARTER________

Product 1

Selling Price	Promotion Expenditure	Development Expenditure	Production (units)
$	$	$	

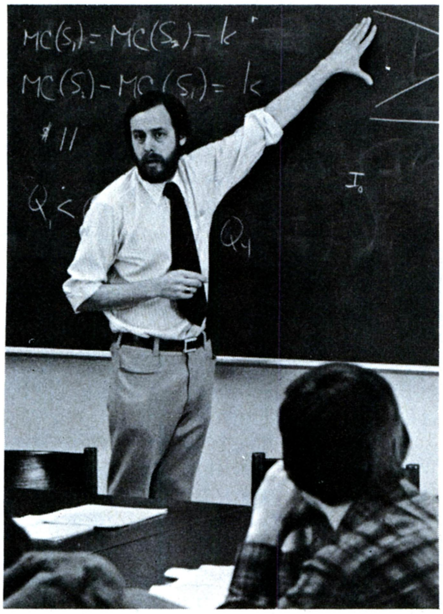
Product 2

Selling Price	Promotion Expenditure	Development Expenditure	Production (units)
$	$	$	

General Decisions

Size of Workforce	Plant Capacity (units)	Dollar Balance in Marketable Securities	Dollar Balance of Loan Outstanding	Dividends	Number of Shares Outstanding
		$	$	$	

Sample Student Decision Sheet



Staelin with students. "Can your decisions stand up in the face of a stockholders meeting?"

at the University of Michigan, responded to student gripes by spicing up the texts.

Staelin coordinates the game, but the big boss is the computer. Feeding in student appraisals of situations from the traditional classroom work, the students get to see regression analysis, linear programming and pro-forma analysis as more than terms in the glossary of Economics 101.

Students are broken down into five teams of six students each. Each team is given 3-million dollars in working capital, members are made corporate managers of a corporation manufacturing two unidentified products within a simulated market. The aim, just as in real life, is to make a profit.

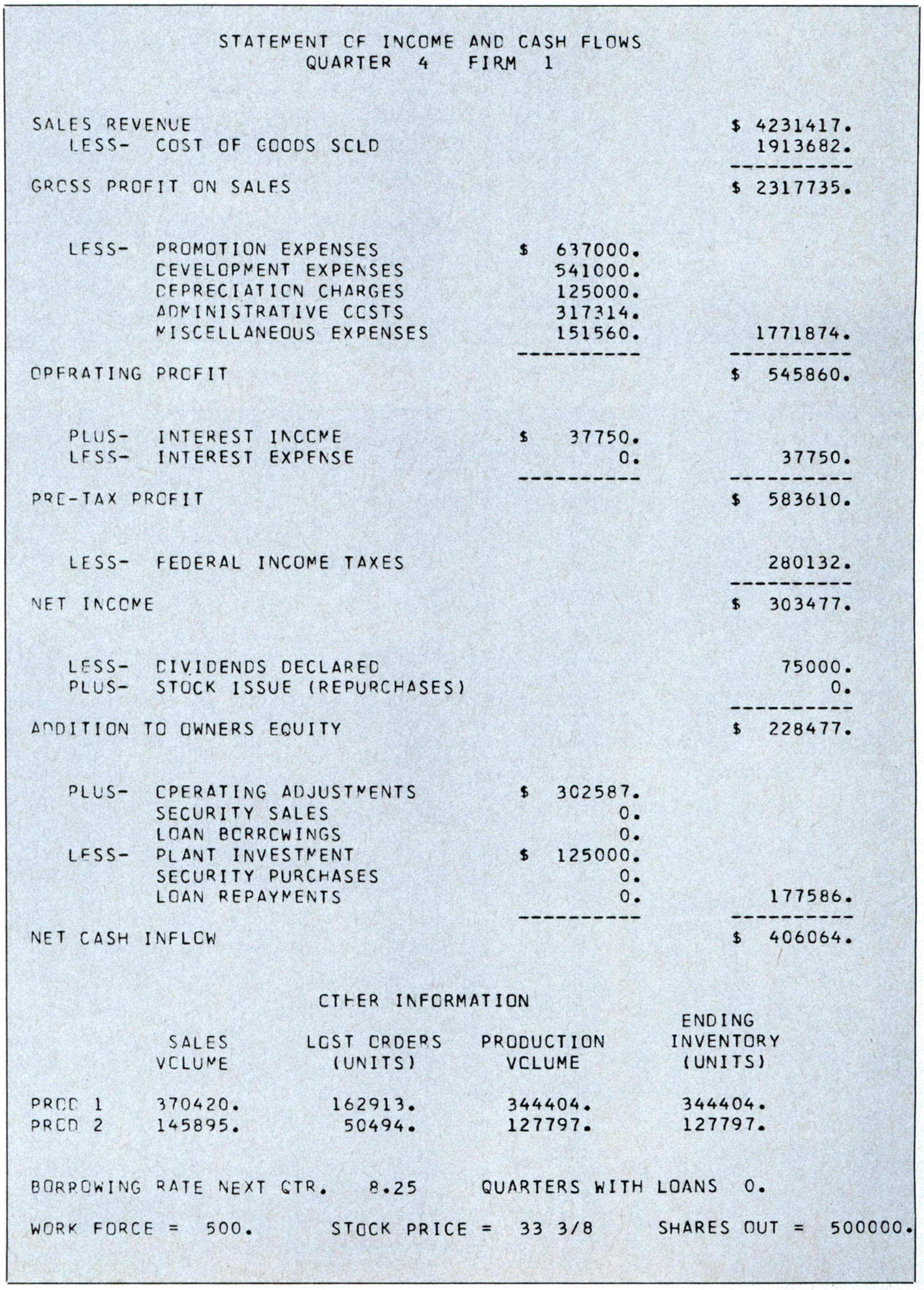
Staelin gets to indulge himself in all his interests at the Amherst campus. He gardens, plays squash, hikes and sails, skates and skis cross-country when he's not watching Amherst College sports. But if he had to choose one activity it would probably be playing with computers. Calling the Amherst College Computer Center "my crossword puzzle," Staelin can usually be found rewriting and improving a program. As coordinator of the Carnegie Mellon game he gets to amuse himself by controlling unseen events, like slapping an overconfident student mogul with an Arab oil embargo to mess up his rosy corporate graphs.

For the students, no details of corporate management are spared. The young decision makers decide the size of the work force, the plant capacity and the amount of each product to be produced. They grapple with decisions on overtime and overutilization of plant capacity in terms of gains vs expense. They must set product price, designate an advertising budget, plow some money into R&D and handle the banking to include loans, stock, dividends, and dollar balance of marketable securities.

As in the real world, some of the student companies squeaked by while others flourished. The students get to see the results of their decisions as the computer tells them if they were wise to hold back on product development to get a more immediate "bang for the buck" through an ad campaign. The computer sometimes has to advise a young hotshot that the results of R&D come late, but last longer than the TV spot.

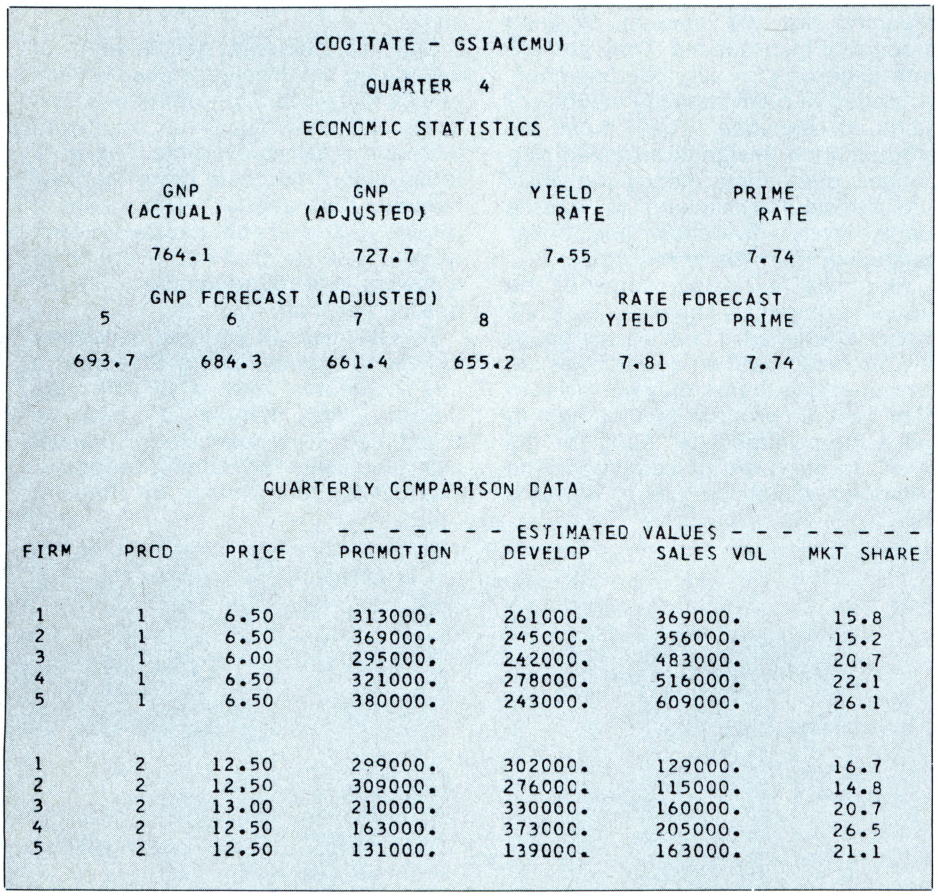
Staelin's students get a whiff of everything but the cigar smoke when it comes to unions. They are bound by a contract specifying $4 an hour with time and a half of overtime. The work force cannot fluctuate more than ten percent per quarter. The contract requires 500 hours per quarter for each worker. The union limits overtime to a maximum of 100 additional hours per quarter per man.

To assimilate all the input necessary to keep the game flowing, Staelin says any computer with a 32,000 byte memory can handle it, and he recommends the exercise for present day executives for training purposes. The IBM 1130 system at Amherst

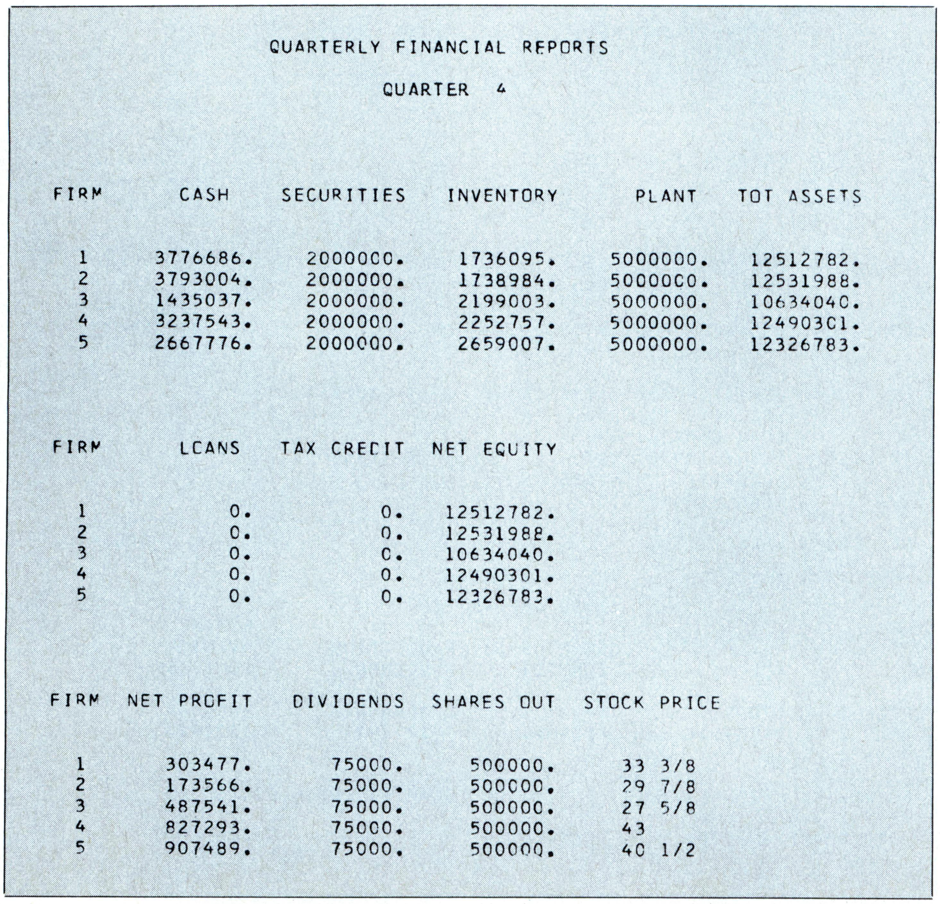


```
                    STATEMENT CF INCOME AND CASH FLOWS
                           QUARTER  4   FIRM  1


SALES REVENUE                                                  $ 4231417.
   LESS-  COST OF GOODS SCLD                                     1913682.
                                                               ----------
GRCSS PROFIT ON SALES                                          $ 2317735.


   LESS-  PROMOTION EXPENSES                 $   637000.
          CEVELOPMENT EXPENSES                   541000.
          CEPRECIATICN CHARGES                   125000.
          ADMINISTRATIVE CCSTS                   317314.
          MISCELLANEOUS EXPENSES                 151560.         1771874.
                                             -----------       ----------
OPFRATING PRCFIT                                               $  545860.


   PLUS-  INTEREST INCCME                    $    37750.
   LFSS-  INTEREST EXPFNSE                            0.            37750.
                                             -----------       ----------
PRE-TAX PRCFIT                                                 $  583610.


   LESS-  FEDERAL INCOME TAXES                                    280132.
                                                               ----------
NET INCCME                                                     $  303477.


   LESS-  CIVIDENDS DECLARED                                       75000.
   PLUS-  STOCK ISSUE (REPURCHASES)                                    0.
                                                               ----------
ADDITION TO OWNERS EQUITY                                      $  228477.


   PLUS-  CPERATING ADJUSTMENTS              $   302587.
          SECURITY SALES                              0.
          LOAN BCRRCWINGS                             0.
   LESS-  PLANT INVESTMENT                   $   125000.
          SECURITY PURCHASES                          0.
          LOAN REPAYMENTS                             0.          177586.
                                             -----------       ----------
NET CASH INFLCW                                                $  406064.


                           CTHER INFORMATION
                                                      ENDING
               SALES      LCST CRDERS   PRODUCTION   INVENTORY
               VCLUME       (UNITS)       VCLUME      (UNITS)

PRCC 1         370420.      162913.       344404.     344404.
PRCD 2         145895.       50494.       127797.     127797.


BORROWING RATE NEXT GTR.   8.25      QUARTERS WITH LOANS  0.

WORK FORCE =  500.       STOCK PRICE =  33 3/8      SHARES OUT =  500000.
```

Sample Program Output



```
                         COGITATE - GSIA(CMU)

                              QUARTER  4

                         ECONOMIC STATISTICS


           GNP                GNP             YIELD             PRIME
        (ACTUAL)          (ADJUSTED)            RATE              RATE

         764.1              727.7             7.55              7.74

         GNP FORECAST (ADJUSTED)                    RATE FORECAST
     5             6            7           8      YIELD        PRIME

  693.7          684.3        661.4       655.2     7.81         7.74




                    QUARTERLY COMPARISON DATA

                            - - - - - - - - ESTIMATED VALUES - - - - - - - -
FIRM      PROD      PRICE     PROMOTION     DEVELOP       SALES VOL    MKT SHARE


 1         1         6.50      313000.      261000.       369000.         15.8
 2         1         6.50      369000.      245000.       356000.         15.2
 3         1         6.00      295000.      242000.       483000.         20.7
 4         1         6.50      321000.      278000.       516000.         22.1
 5         1         6.50      380000.      243000.       609000.         26.1


 1         2        12.50      299000.      302000.       129000.         16.7
 2         2        12.50      309000.      276000.       115000.         14.8
 3         2        13.00      210000.      330000.       160000.         20.7
 4         2        12.50      163000.      373000.       205000.         26.5
 5         2        12.50      131000.      139000.       163000.         21.1
```



```
                      QUARTERLY FINANCIAL REPORTS

                              QUARTER  4


    FIRM       CASH     SECURITIES    INVENTORY        PLANT    TOT ASSETS


      1      3776686.    2000000.      1736095.     5000000.     12512782.
      2      3793004.    2000000.      1738984.     5000000.     12531988.
      3      1435037.    2000000.      2199003.     5000000.     10634040.
      4      3237543.    2000000.      2252757.     5000000.     12490301.
      5      2667776.    2000000.      2659007.     5000000.     12326783.



    FIRM       LOANS    TAX CREDIT   NET EQUITY


      1           0.           0.   12512782.
      2           0.           0.   12531988.
      3           0.           0.   10634040.
      4           0.           0.   12490301.
      5           0.           0.   12326783.



    FIRM  NET PROFIT    DIVIDENDS   SHARES OUT   STOCK PRICE


      1      303477.       75000.      500000.      33 3/8
      2      173566.       75000.      500000.      29 7/8
      3      487541.       75000.      500000.      27 5/8
      4      827293.       75000.      500000.      43
      5      907489.       75000.      500000.      40 1/2
```

proved fully capable of keeping score of the Economics student decisions.

The exercise ran for three weeks. It placed the students in their positions on the ground rules of their firm having been in business one year, the span of time covered by the program simulated three years. "I was quite impressed," reported Staelin when it was over. "The novelty didn't wear off, the students worked extremely hard, their decision making markedly improved," he added. While no academic credit was granted at Amherst, the exercise is presented as a formal course to the grad students at Carnegie-Mellon.

How did the exercise reveal the exuberance of youth in comparison to the typical moves of seasoned executives? "I found little difference," reported Staelin. "Some went after the fast buck, others formed stable long range plans." The students also had the temptations of knowing they were bringing their role in the firm to an end, stepping aside as if they were resigning or retiring. "The way they treated that career milestone was also interesting," noted Staelin. "For some it was important to put the firm in good shape on paper reaping high profits. But for others there was the feeling of responsibility to end their reign with the company in strong long range health.

Staelin found his students surprised at how intense competitive industry could be. In retrospect, he wished he had exercised his role of coordinator a bit more. Although recessions and recoveries were built into the exercise, Staelin was free to introduce any other monkey wrench that came to mind. "Another time I'd call a surprise stockholders meeting," he concluded. "I'd want to see if my managers could survive questions from the floor. Many of them sold off shares for short term gain. They should have been exposed to stockholders who wouldn't stand for it." Staelin clearly relished playing the role of the irate stockholder himself.

When will Amherst Economics majors get to make these decisions for real? "We're talking Vice President and Division Manager level executives, well into their forties," guessed Staelin who quickly added young fast growing companies might be staffed with executive talent much younger.

How many of these original thirty students who played the game will be making their decisions for New England firms? "It's hard to tell, most of my people are planning on grad school, but many come from New England, some will doubtless settle here," says Staelin.

Wherever they settle, when the day of corporate decision making arrives, they can look back and recall they've done it all before, back on the campus at Amherst. ■

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*Wang listings available from Osborne & Associates on cassette or hard disk.

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Osborne & Associates is converting its business systems from Wang BASIC — as it was originally published — to CP/M CBASIC, which runs on many floppy disk-based microcomputer systems. The disks for each book sell for $250. Once you buy the floppy disk you can copy it, resell it, change it or use it. We place no restriction on the magnetic surface; we copyright only the printed word in our books.

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Simulation and Gaming References

DIRECTORIES OF SIMULATIONS AND GAMES

Directories contain descriptions and complete bibliographic information for purchase. The three cited here are the most comprehsneive.

Belch, Jean, Contemporary Games. Detroit; Gale Research Company, 1973. Descriptions of 900 gaming devices in a variety of subject areas at all levels of education. This 560 page directory sells for $35.

Horn, Robert E., The Guide to Simulation Games (third edition). Cranford, New Jersey: Didactic Systems, 1976.

This directory is published in three versions:
- academic games only, 500 pages, $24
- business games only, 100 pages, $12
- combined academic and business games, 600 pages, $27

It includes user comments and other information for selecting, using, and evaluating simulation and gaming materials.

Stadsklev, Ron, Handbook of Simulation Gaming in Social Education (Part II: Directory). University, Alabama: The University of Alabama, Institute of Higher Education Research and Services, 1975.

This 350 page directory describes 700 simulations and games in the area of social sciences and studies. In this area it is the most complete directory available. It sells for $12.

ORGANIZATIONS

There are several organizations that, in addition to publishing gaming materials, offer services to game users. Three of these are listed below.

North American Simulation and Gaming Association (NASAGA), formerly called the National Gaming Council. This organization's membership is composed of interested individuals representing all areas and disciplines in which gaming is used, both educational gaming and non-educational gaming. Membership fees are $5.00 per year. NASAGA c/o COMEX, University of Southern California, University Park, Los Angeles, California 90007.

Simulation and Gaming Association (SAGA). Membership is composed primarily of teachers at all levels, but is open to anyone interested in educational gaming. SAGA publishes a quarterly journal and produces several simulations and instructional games. It also features a sharing and consulting service for teachers. Membership is $5.00 per year. Simulation and Gaming Association, 4833 Greentree Road, Lebanon, Ohio 45036.

Simulation Sharing Service (SSS). Membership is composed primarily of those interested in the use of gaming techniques in Christian education. The organization publishes a newsletter as well as serving as a consultant for those interested in religious gaming. Membership is $5.00 per year. Simulation Sharing Service, 221 Wiley Street, Morgantown, West Virginia 26505.

Zephyros Educational Exchange. This organization is composed of teachers and parents who write and print activity books and games. Memberships are $10.00 per year. For this fee members receive two Z-Boxes each containing books, magazines, and games; a real bargain. Their catalog and membership information may be obtained by writing to Zephyros Educational Exchange, 1201 Stanyan Street, San Francisco, California 94117.

PERIODICALS

Of the available journals, these cited here are among the most useful.

SAGA Journal. This periodical is the quarterly publication of the Simulation and Gaming Association cited in the previous section. Yearly membership rate is $5.00 per year and this journal is part of the membership fee. For information write to SAGA, 4833 Greentree Road, Lebanon, Ohio 45036.

Simulation and Games: An International Journal of Theory, Design and Research. This quarterly journal emphasizes research studies and articles on gaming theory. The yearly subscription rate is $18.00. Sage Publications, 275 South Beverly Drive, Beverly Hills, California 90212.

Simulation/Gaming. This is a bi-monthly publication dealing with nearly every aspect of simulations and games. It features reviews, research, current issues, and a great variety of reports and articles. Subscription rate is $6.00 per year. It is a must for anyone interested in gaming. Simulation/Gaming, P.O. Box 3039, University Station, Moscow, Idaho 83843.

Strategy and Tactics. This bi-monthly magazine deals exclusively with conflict simulations and features military history articles, game design articles, and a conflict simulation in each issue. Cost is $14.00 per year. Available from Simulations Publications, 44 E. 23rd Street, New York, New York 10010.

COMPANIES AND CATALOGS

Nearly every company in the publishing field offers some simulations or games in their respective catalogs. A complete listing is beyond the intent of this book. However, the several companies cited below are among the best and deal almost exclusively with gaming materials.

Damon/Educational Division. This company distributes a number of elementary and secondary simulations and games in the areas of mathematics, science, and ecology. You may obtain a free catalog of their materials by writing to Damon/Educational Division, 80 Wilson Way, Westwood, Massachusetts 02090.

Educational Manpower, Inc. (EMI). This is a company that distributes simulations, games, and multi-media materials from a variety of publishers. You may write and obtain a free elementary school level catalog or their catalog of junior high to college level materials. This is an excellent source for seeing what gaming materials are available. EMI, Box 4272-F, Madison, Wisconsin 53711.

Fearon Publishers. This company produces and distributes a great variety of books containing games for primary, intermediate, and junior high students. Some of their more popular titles include Games Students Like to Play, 30 Math Games for Elementary, and Science Games. You may obtain a free catalog of their publications by writing to Lear Siegler, Inc., Fearon Publishers, 6 Davis Drive, Belmont, California 94002.

Games Central. This company produces and distributes gaming materials as well as offering consulting services about gaming. You may obtain a free catalog of their materials by writing Games Central, 55 Wheeler Street, Cambridge, Massachusetts 02138.

INTERACT. This company limits its activities to producing and distributing simulations that are generally of the extended-play type. You may obtain a free catalog of their materials by writing INTERACT, P.O. Box 262, Lakeside, California 92040.

Metagaming Concepts. This company produces and distributes a number of science fiction and fantasy simulations. These are discounted for those who subscribe to their publication entitled Space Gamer. You may obtain a free catalog of their simulations by writing Metagaming Concepts, Box 15346, Austin, Texas 78761.

Simile II. This company produces and distributes simulations and games as well as offering workshops and consulting services. You may obtain a free copy catalog of their materials by writing Simile II, 218 12th Street, P.O. Box 910, Del Mar, California 92014.

Social Studies School Service. This company distributes simulations, games, multi-media and print material from a variety of producers of social science materials. You may write for a free elementary catalog or their catalog of junior high to college level materials. This is an excellent source for seeing what gaming materials are available. Write to Social Studies School Service, Dept. 87, 10,000 Culver Boulevard, P.O. Box 802, Culver City, California 90230.

Reprinted from *Design Your Own Game*, 2nd Edition by McLean and Raymond, The Simulation and Gaming Assn., 4833 Greentree Rd., Lebanon, OH 45036.

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Personal Computers at the University of Michigan and An Assessment of Potential Impact

Karl L. Zinn

At the University of Michigan's Center for Research on Learning and Teaching (CRLT) we are examining the impact of microcomputers and personal computing on college learning and teaching activities. We define personal computing broadly to include all systems that personalize or individualize in any useful way: portable hardware, task-oriented software, user-defined interface, and so on. However, we are particularly interested in the impact of inexpensive, single-user computer systems backed up by computer-to-computer communications.

In the first part of this informal report we describe uses of single-user, personalized systems at the University of Michigan. Simulations and instructional games have been transferred from the central timesharing system to make them more accessible to students, including opportunities to modify programs and create new ones. A non-credit course providing literacy in personal and home computing has been designed. Word processing has been made available to selected students, and the impact on writing and communications activities has been examined. Although information management aids have not yet been transferred to the single-user microcomputer, problem-solving aids have been provided in desk-top machines for laboratory and special project activities.

Then we discuss the implications of the new technologies for improving access to higher education. Inexpensive but capable computers will play a key role in extending and personalizing access to higher education, especially for non-traditional learners.

Personal computing is not new, but it does need reinterpretation and reassessment. For some years at Dartmouth College all students have been assumed to be computer users; the computing center ID is the same as the student ID and is valid from enrollment to graduation. At the University of California at Irvine computing exercises are part of many courses, and it is quite common for students not enrolled in a course also to use its computing exercises just as they borrow library books purchased by the library for other courses. At the University of Michigan students have been given experience with software designed especially for handling personal-note files, problem-solving procedures, and class communications.

In one sense the microcomputer is only a cheaper version of the minicomputer.

The commercial push to sell personal computers for home use (including education) is already evident. Ads are common on television and in popular magazines. They are directed at families as well as small businesses, appealing to personal interests as well as professional. Some approach personal computing via games and entertainment, others via programmable calculators, and some as small-business systems. All these kinds of personal computers will very likely be purchased for a large number of homes. Such computers could be very helpful in educational and professional activities; at the University of Michigan we attempt to anticipate the machines yet to be designed which will serve well these multiple purposes.

Microcomputers in Teaching at U-M

Microprocessors and microcomputer systems are popping up all over the campus in educational applications. We find this a natural evolution from the use of minicomputers in laboratories and teaching situations. In one sense the microcomputer is only a cheaper version of the minicomputer, approximating all or most of its capabilities. But the microcomputers also appear in terminals called "intelligent" because of the local computer logic and memory. This permits processing activities previously done entirely on the timesharing system to be done locally, in part.

Word processing is a good instance of computing which is burdensome on the timesharing system, so is moving to an intelligent terminal. Early word-processing systems could not match the central computer system in power, particularly for preparation of proposals, reports and other lengthy documents. However, today's microcomputer-based systems can do as well in most areas and much better in some. Current equipment offers very much more than the central system in ease of formatting and in quality of and control over output. Some word-processing installations are using the timesharing system for text manipulation that might better be done on a stand alone or satellite system. On the other hand, an inexpensive, remote terminal which can do visual-mode editing (that is, is intelligent) will open up timesharing capabilities to many more users.

Students report a number of benefits of computer-assisted text preparation. The following comment is typical. "I have been an extensive user of the word processor for everything from a thesis and legal briefs to poetry. It is an invaluable tool. It provides a visually attractive (and impressive) finished copy. It encourages me to polish my work (it takes the pain out of going back to get it just right). Also I am more likely to work further on a project after the teacher has critiqued it. This tool makes written work more fun! At a time of declining communications skills, this may be the major advantage."

Karl L. Zinn, Center for Research on Learning and Teaching, University of Michigan, Ann Arbor, MI 48104.

Microcomputers in the Lab

Microcomputers are used by many labs as part of the instrumentation for research purposes. Students working with such equipment in the sciences and engineering gain important educational experience. In addition, the students enjoy increasing use of microcomputers in regular labs where they wouldn't be needed for instrumentation. Micros are also being used in Biophysics and Biochemistry. CRLT (the Center for Research on Learning and Teaching) is involved in planning activities for courses in Natural Resources, Biology, and Psychology. Virtually all of the sciences will be affected.

For example, a program was prepared by William Powers to demonstrate the use of microcomputers in a hospital. It models the effects of an anticoagulant drug used with surgery (warfarin dosage strategies and the prothrombin complex activity). The model fits easily in an 8K PET 2001 and reads patient data from cassette tape. Each (hypothetical) patient has a file containing full name and a listing of parameters associated with the kinetics of warfarin in his or her system. These parameters, individual to each patient, are determined by another program which writes the data tape. Presently the program is used to simulate hospital data and dosage experience, as well as to explore models. Figure 1 shows a dosage strategy which does not bring the prothrombin complex activity down fast enough, and Figure 2 overdoes it. Prospects for use of many such aids in hospitals and clinics are very good.

Another example comes from the psychology lab. Students are given a program on a TRS-80 or PET 2001 that presents stimuli and records data for simple perception and reaction time experiments. They are encouraged to revise the program to vary the experiments beyond the limits of the preprogrammed logic and parameters. The cost of the microcomputer is equivalent to that for other lab equipment. Electricity and maintenance are about the same as that for an office typewriter. Economy in use is very important for lengthy studies and experimentation by undergraduates. The software of a general-purpose micro provides good control of the screen display and timing. Figure 3 shows the appearance of one of the reaction time displays (programmed by Diane Sallade) with feedback to the subject in the experiment.

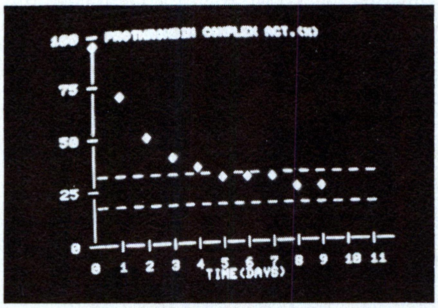


Figure 1

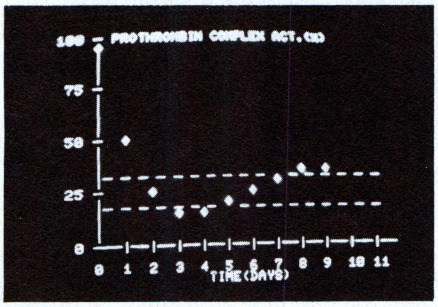
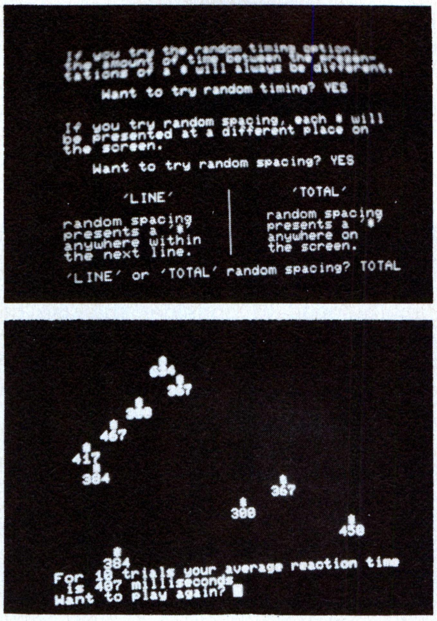


Figure 2



```
If you try the random timing option,
the amount of time between the presen-
tations of a * will always be different.

   Want to try random timing? YES

If you try random spacing, each * will
be presented at a different place on
the screen.

   Want to try random spacing? YES

      'LINE'        |        'TOTAL'
random spacing      |   random spacing
presents a *        |   presents a *
anywhere within     |   anywhere on
the next line.      |   the screen.

'LINE' or 'TOTAL' random spacing? TOTAL
```

```
 384
For 10 trials your average reaction time
 is 407 milliseconds
Want to play again? ■
```

Figure 3

The introductory chemistry lab now includes computer assistance through a dozen PETs and more will arrive before this article is printed. Our chemistry faculty have for a long time been interested in applications of the PLATO Computer-based Education System and others which provide useful graphics with lab simulations. However, until the cost was low enough to serve over a thousand students they were not interested. Micros make that possible. Half a dozen programs have been prepared by William Butler and Henry Griffin which make good use of graphics, simple animations, and interaction with the student users. A snapshot of the titration experiment is shown in Figure 4. Conversation between program and student takes place in a "window" with the animation continuing elsewhere on the screen. Graphics on the PET are limited, but sufficient to this purpose. Control of when and where information appears on the screen is used well.

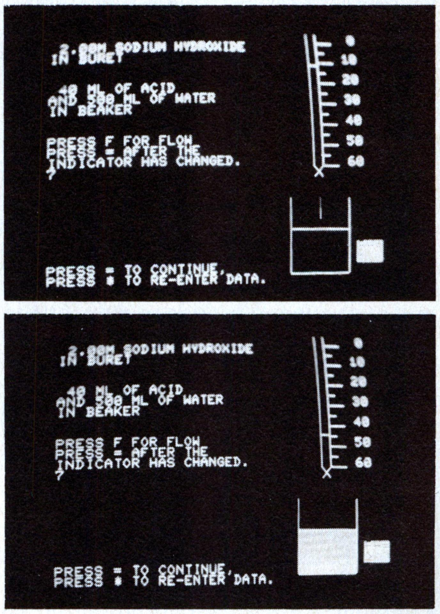
Simulation

Simulations have even wider spread of application. The benefits are well known: cost saving, time saving, risk reducing, etc. In addition to simulations in each of the science laboratories listed above, CRLT is working with people in political science, sociology, education and history. The machine is available whenever its owner decides to use it since no telephone connection is necessary to obtain the computing power. The graphics are immediate and easily projected. These and other characteristics contribute to qualitative differences in the use of personal computers in simulation.

Instructional Games

Instructional games form a category separate from that of simulation. Well designed instructional games have a favorable history at the University of Michigan, particularly in business, sociology and education. Games become more interesting and potentially more valuable when they have a computer component. The computer handles complexity, control, concealment, randomness, and records. Games on microcomputers today are mostly of the arcade variety. However, faculty members are working on enjoyable drills for improving language skills or fun games which stimulate use of encyclopedias and other reference works. In the meantime, adult learners are having a good time with games written for the Commodore PET for kids.

In one interesting game programmed by Brad Compton, the student is given the task of moving his vehicle through a succession of hostile regions. The motion is in part random, and in part under the control of the



```
2.00M SODIUM HYDROXIDE
IN BURET

40 ML OF ACID
AND 200 ML OF WATER
IN BEAKER

PRESS F FOR FLOW
PRESS = AFTER THE
INDICATOR HAS CHANGED.
?

PRESS = TO CONTINUE,
PRESS * TO RE-ENTER DATA.
```

Figure 4

Michigan con't ....

student. In one version of the game, the vehicle is an inert molecule which might be consumed by a reactive agent in any hostile region. The player needs to infer the behavior of the membranes between the regions (when the molecule will be permitted to pass) and the agent (when the reactive molecule will move toward the inert one). In this game, one student plays against the computer. To obtain discussion of the method, a second student is invited to tutor the first in how best to play the game. Each student has a chance to change the rules stored in the computer program, and test the ability of his or her friend to infer the new rules.

Games become more interesting and potentially more valuable when they have a computer component. The computer handles complexity, control, concealment, randomness, and records.

An electric game of tag (also by Brad Compton and adapted by CRLT for science education) gives two players control of spaceships moving about within a rather dense array of barriers. However, some points in the walls actually are "doors" providing instant access to other points in the array. In the complex version the players need to infer the rules of instantaneous transport via these "spacewarps" to move quickly and predictably about the space. Sometimes the warp factor changes a characteristic of the spaceship (direction, power, or reliability) as well as the location. The complexity of the game can be varied from simple, robot-like exploration to highly competitive games requiring quick learning of the hidden pattern of spacewarps and conversions. Again, the students are invited to change the rules as a further test of understanding and to challenge friends to play. All the games, although fanciful, are to be used by Carl Berger in science education to introduce and then probe basic concepts of theory, models and experimentation.

Tutorial Use - A New Possibility

Tutorial use of computers, particularly in the programmed instruction mode, has not been encouraged by CRLT for the University of Michigan. For most of the University students this approach does not give enough control over the pace and style of learning. Furthermore, the computer terminal, telephone line, processing and storage are better used for other kinds of computer-based learning activity. However, inexpensive and personal computers may change this. If students owning personal $300 computers can buy a cassette providing something equivalent to the old "College Outline Series," then the University and its faculty need to consider the use of microcomputers for tutorials, at least for remediation. One faculty member is already providing some math study aids through microcomputers.

Many other ways of using computers would have to be listed if this were to be a complete list. At least one more must be mentioned, probably the most important of all. Training in computer use has been advanced in a significant way by the introduction of microcomputers. CRLT is not at the moment concerned about Computer Science or Computer Engineering, but about education for applications in other areas: graphics in engineering, linear programming in business, information systems in law, patient records in medicine, class records in education, etc. These are only some of the places where faculty members are working on demonstration exercises or writing materials for computer education regarding micros in the professions or disciplines. In addition, CRLT has designed a non-credit course in computer use and programming built around an inexpensive, personal computer available through the local computer stores.

Implications for Planning and Research

CRLT is helping various units in the University plan for new uses of computing in teaching and learning. We describe four points of current planning at the University of Michigan, and research implications for microprocessors and personal computing.

1. We cannot extrapolate from (typical) computing in higher education. A revolution is going on that will put computing into everyone's home.

Computing in higher education has been based on expensive equipment of rather limited scope. We are not willing to make simple extrapolations from experiences with equipment and procedures which led us to consider computer efficiency more important than learner convenience. Most research on CAI used systems that have been made obsolete by a revolution in microelectronics. Restrictive terminals and slow data rates provided only a small window on the capabilities of computer aids to learning. New research will be done in a context that is different in qualitative and quantitative ways.

Computing equipment will be available in much larger numbers. Higher education will enjoy the use of 1,000 times more personal computers than we now have timesharing terminals. Many of these personal devices will have a communicating option so that they can talk with other personal computers directly and with timesharing computers.

Computing equipment will be much more responsive. The design of personal computers makes possible more rapid data rates, and this facilitates graphics and sound and other modes of communication between computer program and the user.

Personal control of computing equipment will be a factor in increased use in education. Systems will be personalized for convenience, and also gain certain intangible characteristics associated with being owned and entirely under one's own control.

Computing will be common in everyday life. Not only will people know about computers and their uses; access to timesharing systems and single-user machines will be common for personal use. Home entertainment and budget planning are certain to be among the applications; education and information retrieval applications are likely also if personal computers can be coupled with the large but inexpensive storage capabilities of videodiscs or their equivalent.

2. Anticipating future capabilities and discontinuities is important. What will be the impact of new technologies on education?

We are conducting an assessment of the impact of microcomputers and telecommunications on education. Interviews, scenario generation and interpretive modelling shed some light on what makes a good application of new technologies.

A list of some of the questions of social implications for planners to consider is given below.

Impact on the learner. What will be the impact of microcomputers and video information systems as tools for student learning? What new intellectual skills will students need to have in order to use the new technologies? Which skills will become much more important because of use of the new technologies? How will attitudes change regarding the technology employed, the topics studied, knowledge in general, sources of information, interaction with peers, etc.?

Impact on the teacher. What will be the impact of satellite and optical-fibre communications on access to current information and resource people?

How will improved access to good information affect the role of educational institutions in society?

What changes in the role of the professor will be appropriate to the new technologies? How will these changes for the professor be different in various disciplines or kinds of institutions? What will be the impact of improved access to excellent lectures on standards for educational materials, including live lectures as well as packaged materials? How will improved access to good information affect the role of educational institutions in society?

Impact on the scholar. What difficulties will arise as telecommunications replace or extend face-to-face communications? How will telecommunications change the professional meetings of scholars and teachers? What will be the impact on environments for scholarly work and professional training? How will the speed of information exchange and the pace of electronic publication affect the quality of scholarly work?

Impact on the learning community. Will community centers assume more of the delivery of education, not only through community colleges per se but in regional centers of universities? How will telecommunications (and energy costs) change educational travel and campus life? In what ways can electronic storage and transmission replace or extend vocal communication?

The major directions of new technology in education are shaped by economic, social and political factors. However, the benefits of such changes can be enhanced through careful attention to desirable faculty roles, improved student preparation and more humane applications of technology. Furthermore, if planners can successfully anticipate negative side effects of technology, they will help reduce the undesirable impact, for example, on values, on social experiences, and throughout a lifetime of learning.

3. As computing becomes more available and personalized, it becomes increasingly useful to the student as a scholar. Using the computer as a scholarly tool, the student moves more easily into a community of scholars and learners.

Initial uses of microcomputers at the University are simply extensions of what has been successful with the timesharing system. Simulations become more available to students, and easier for them to modify. Earlier we listed examples from political science, sociology, history and education. Instructional games are being adapted for micros in the areas of business and natural resources. Remediation and other tutorial activities become practical for large numbers of students. Some work is in progress in math and language skills. Applications essential to the discipline or profession are becoming more popular: graphics in aerospace engineering, linear programming in business, information systems in law, patient records in medicine, class records in education, and so on.

Dramatically lower costs lead to rethinking what is useful to do with computers. CRLT is providing access to readily used word processing through micros, and examining the impact on students, assignments, grading, job seeking, and other aspects of student and professional life. Increased student research has been facilitated, and not just in computer science and computer engineering. Lab instrumentation and complex computation aids have been implemented for chemistry, biology, biochemistry and biophysics (medicine). Information handling and analysis is common in chemical engineering, economics and psychology.

Many of these applications are self-justifying; professors and others making decisions about how to use resources need only see the positive changes in curriculum brought about through computer assistance. In some disciplines, equipment will be acquired as any other equipment is purchased for laboratories, or recommended for student purchase as are calculators (previously, slide rules) and dictionaries. However, some of the changes will be so dramatic as to require more careful attention: deliberation by curriculum panels, reviews by technical experts, and assessment by teams of social scientists. We expect adoption by students to continue regardless.

4. The implications of personal computing for higher education will be dramatic, even to the extent of hastening the demise of some institutions!

A shift in the responsibility for learning will come about, in part as a result of improved access to information and information processing. Authors and course designers will set general guidelines, confident that students find considerable assistance in computer processing of text or models, as well as through improved learning skills apart from computers. But what skills need to be improved, and what new skills will be required?

How can institutions survive these changes, and which institutions should not survive?

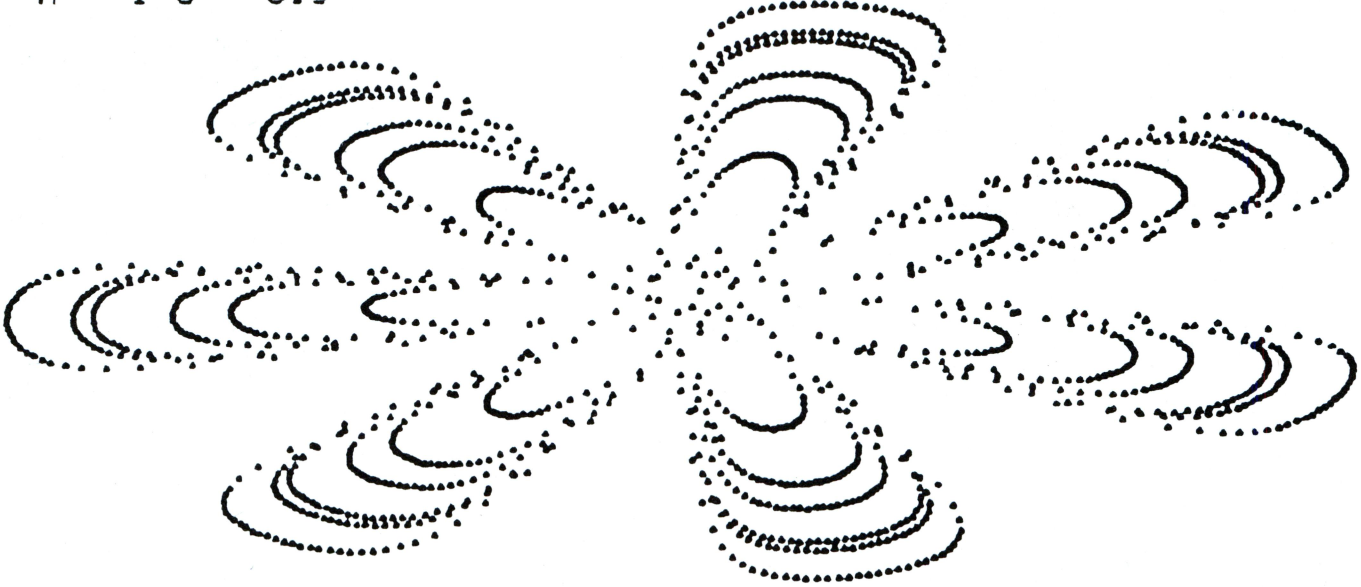
The advantage which the professor holds over the student in terms of knowledge and skills as a result of many more years of study and direct contact with others expert in the discipline will be reduced. Students will access more information directly than has been possible with book formats for typical learners. Computer aids will assist where study skills are lacking, and even sharpen those skills and promote new ones. How will the roles of professor and student be altered?

Impact of computing and telecommunications on continuing and adult education will be considerable. Initially the professional person with a need for more information (and recertification) will find considerable assistance in computer-based media systems (videodisc is particularly attractive). Eventually this will extend to all of adult education. What will be the impact of colleges and universities of various kinds? How can institutions survive these changes, and which institutions should not survive?

These and other changes are being explored in our study of the impact of microcomputers and telecommunications. We welcome your participation. ■

COMPUTER NEWS
Hody

A = 1 C= -0.9



Gumowski

John Lansdown

GUMOWSKI is written in BASIC for a Tektronix 4051 which may be of interest to readers who have systems able to plot random points. The algorithm is based on work by J. Gumowski and C. Mira who, in fact, discovered the art potential by accident during their work on control theory, and the interesting principles should be more widely known. This is described in their paper, "Point Sequences Generated by Two-dimensional Recurrences," *Information Processing 74,* pages 851-855, North Holland Publishing Company.

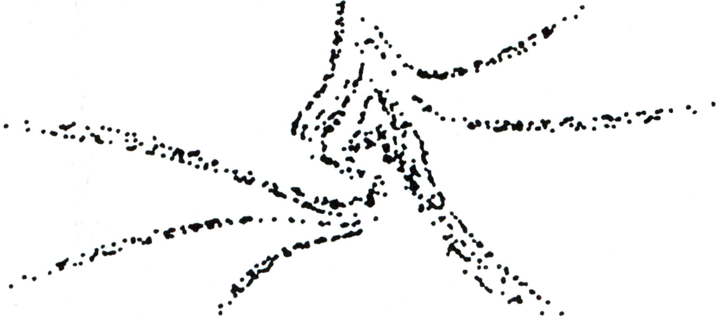
As you see from the examples, slight changes in the parameters make very great changes to the output.

The program should be fairly self-evident with the following notes:

Line
100 initializes the system
110 clears the screen
120-150 set the screen window with 0,0 in the center
160-180 set initial values of the variables
190-210 call for and echo the input of parameters
220 holds the temporary value of old X
230 calculates the new X
240 calculates the new Y (using the old and the new values of X, so don't be tempted to calculate the last part of the expressions in a different way)

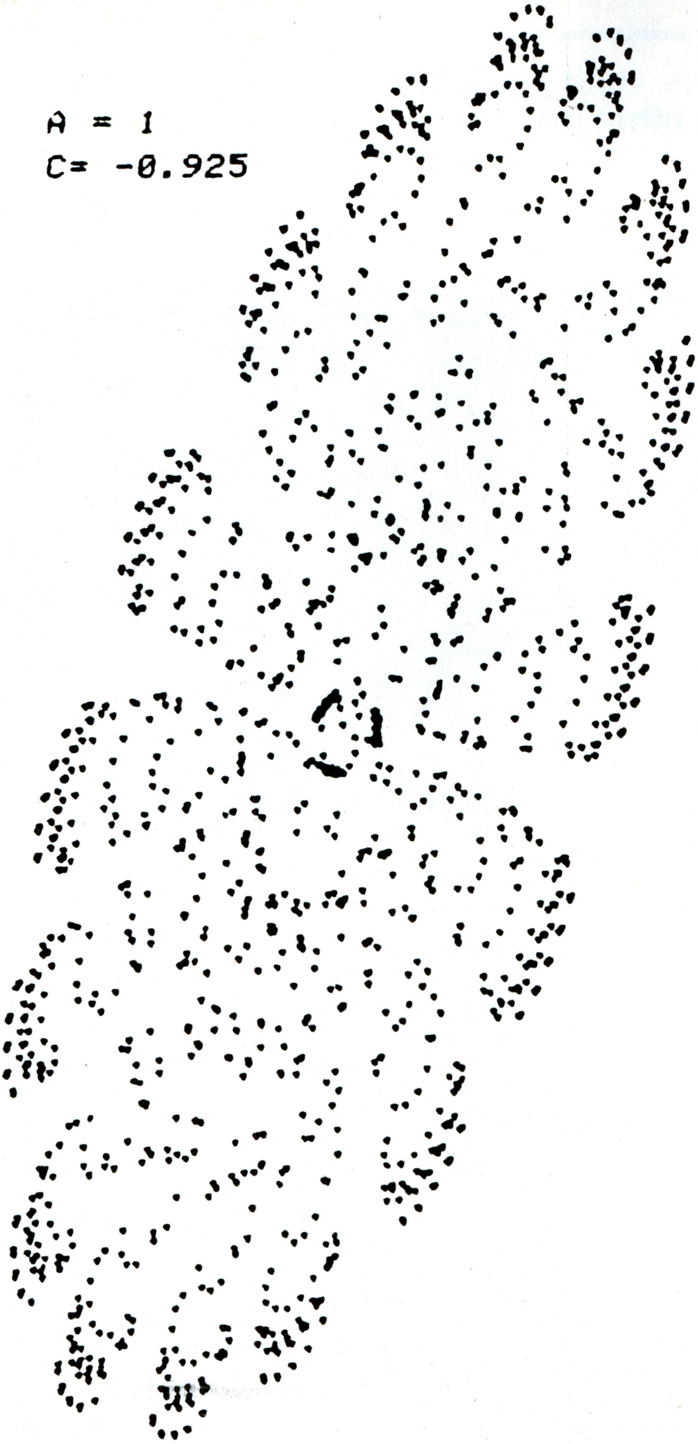
```
100 INIT
110 PAGE
120 F=0.8
130 READ W1,W2,W3,W4
140 DATA -65,65,-50,50
150 WINDOW W1*F,W2*F,W3*F,W4*F
160 I=1
170 X=1
180 Y=1
190 PRINT "INPUT A AND C :";
200 INPUT A,C
202 PAGE
210 PRINT "A = ";A;" C= ";C
220 S=X
230 X=A*Y+C*X+2*X*X*(1-C)/(1+X*X)
240 Y=-S+C*X+2*X*X*(1-C)/(1+X*X)
250 MOVE X,Y
260 RMOVE 0,0.1
270 RDRAW -0.1,-0.2
280 RDRAW 0.2,0
290 RDRAW -0.1,0.2
300 I=I+1
310 IF I>1500 THEN 330
320 GO TO 220
330 HOME
340 END
```

A = 0.8 C= -0.9

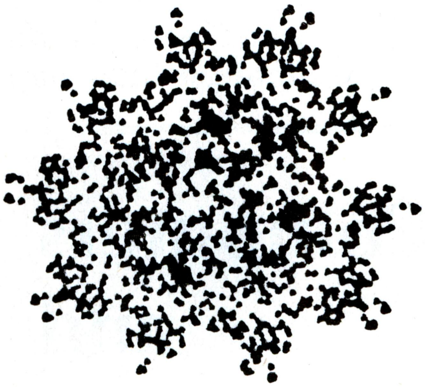


John Lansdown
Computer Arts Society
50-51 Russell Square
London WC1B 4JX
England

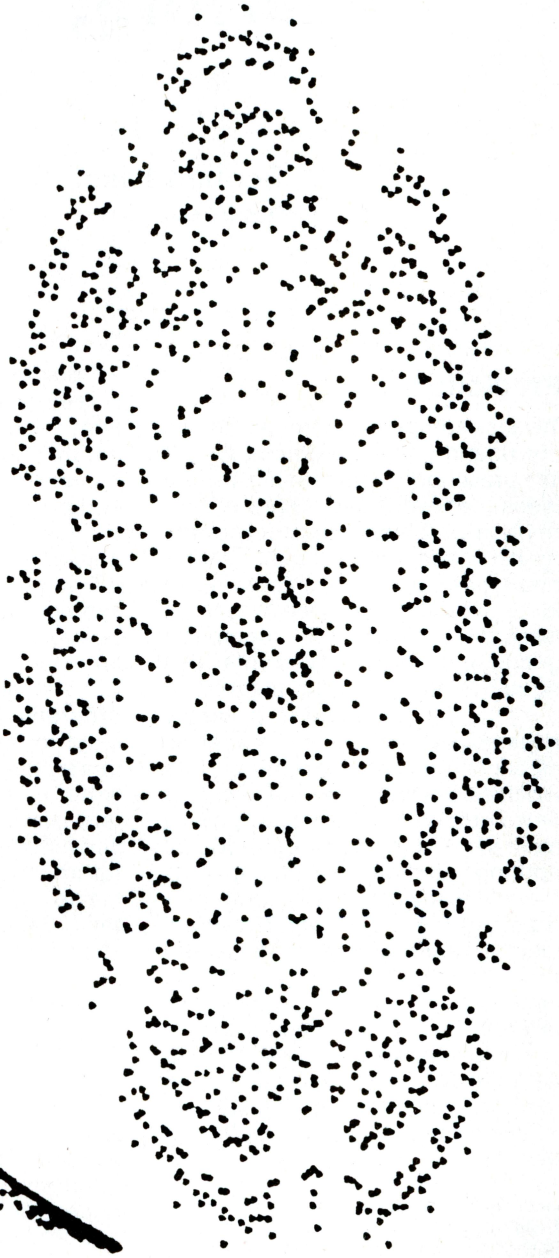
A = 1
C= -0.925



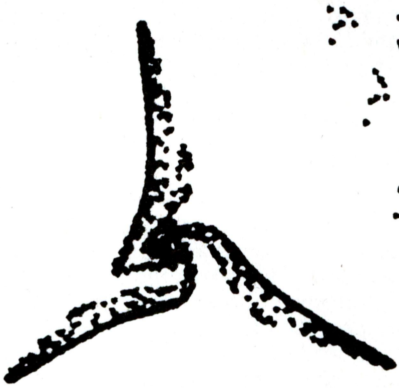
A = 1 C= -0.3



A = 1 C= -0.89



A = 0.9 C= -0.5



250 moves the cursor to the calculated point
260-290 draws a little triangle
300 increments the count
310 checks if the count exceeds 1500
320 returns to line 220 if the plot isn't finished

It isn't possible (for me, at least) to predict the form of output but varying A seems to change the basic shape of the plot whilst varying C seems to alter details. A should be kept less than or equal to 1. F is used to scale the output.

The more points plotted the better — try experimenting. ■

Tiny, cheap computers and related electronic devices, all talking to each other, will have more uses in education than paper-and-ink, blackboard and chalk.

Computers and Early Learning

by Bernard Banet

photos by Gary Easter

A Prediction

The technology of microelectronics will profoundly affect elementary and even preschool education in the decades ahead. We know that computers-on-chips will incorporate, integrate and transcend earlier technologies. But how can they be used by young children? Isn't it necessary to know a computer language and to use a typewriter-like computer terminal in order to talk with a computer? The answer, probably anticipated by the reader, is that as costs of computer systems tumble and capabilities advance, the barriers that impede computer use are rapidly being eliminated. The typical instructional computing configuration in schools will evolve toward microcomputer-based stand-alone systems. These will support a great variety of input and output modalities, replacing exclusive reliance on the familiar printing terminal and CRT. For home applications, too, microprocessor-based video game units and "personal" computers are being developed with emphasis on user accessibility and multiple I/O modes.

Spoken words, a touch on a display screen or digitizer pad, the beam of a light pen, a musical keyboard, a handwritten or typed symbol, the movement of a joystick, will all provide computer input. An interactive electronic system can respond with letters and numbers, of course, but also by playing back an audiovisual recording, synthesizing speech, producing music, or even generating three-dimensional animated color graphics.

It is not necessary to know a programming language in order for a child to interact with a computer, any more than it is necessary to be able to write a script in order to watch a television show. The powerful and convenient computer languages of the future, however, will be more accessible to elementary school youngsters than BASIC and should become an important part of the curriculum.

Replacing Paper, Not People

When one mentions computers-in-education to most educators, a concept of programmed instruction, delivered step-by-step through the computer, comes to mind. This is indeed the classic "computer assisted instruction" (CAI) style, intended to capture the active interchange of a patient and skilled human tutor with a student. In practice, person/machine dialogue usually falls far short of this ideal. CAI approaches to computer use utilize a behavioristic paradigm of teaching/learning modeled on the "shaping" process, in which the teacher (or experimenter) "reinforces" the student for making successive approximations to the *teacher's* final objectives. A careful task analysis of the final desired performance is used to design the sequence of instructional "frames." To a student, though, the carefully developed sequence can be tedious or frustrating. There is no magic that assures success in a step-by-step format any more than there is in the textbook format. CAI of the programmed variety remains a Teacher Initiates—Student Responds model.

Let us not, however, make the mistake of equating computer utilization in education with any single mode of learning, including the CAI format. Quite possibly, the initial experiments with computer-assisted instruction will be to all computer applications in education what programmed textbooks and workbooks are to the total universe of applications of *paper* in education! The computer will be such a ubiquitous tool that preparing students to master its many applications will probably become a major goal of education, just as students now must master the many uses of paper-based information

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Learning Con't......

systems: learning to read, write, type, and locate information in a library.

Tiny, cheap computers and related electronic devices, all talking to each other, will have more uses in education than paper-and-ink, blackboard and chalk. Every current use of paper in education will be enhanced by electronic systems. Look to the microcomputers in use in homes and schools in the years ahead to combine the features pioneered by systems such as PLATO, TICCIT, MIT's "turtles," and the Xerox Palo Alto Research Center's "dynabook," but in sizes and prices like the PET's and TRS-80's of today. RAM and mass storage will no longer be major constraints for the typical application, and the delays due to timesharing will be a thing of the past. What will this mean for a child's first years of learning?

Computers as Learning Aids for Young Children

Interactive games. From the viewpoint of this author the mode of computer utilization that holds the most obvious promise for young children is the presentation of learning in gamelike situations with immediate feedback. In our preliminary investigations of the applications of computer systems at the High/Scope Elementary School and High/Scope Preschool in Ypsilanti, Michigan, it is the fascination with the pinball-like response that stands out as one watches young children in front of a computer terminal, whether the child is interacting with PLATO, or with a minicomputer-based timesharing system, or with a Commodore PET, or with the University of Michigan's Amdahl mainframe and audio response unit speech synthesizer.

In our work with preschool and elementary children we are discovering that computer games can powerfully motivate the learning of basic skills and sophisticated concepts. If one builds into games an opportunity to increase skill systematically (such as by doing something faster each time) or to advance to a more complex or difficult task, it may not be necessary to "manage" the student's progress by maintaining elaborate student records in the computer. Each student's file can be in his or her own head, with teachers and parents looking at printouts of the actual games the student has been playing to get an idea of the child's level of achievement. Rather than prescribe the child's learning experience, the computer can present an inviting menu from which the child can choose, freeing him or her from adults' limited ability to prescribe optimal educational experiences. Computer games can simultaneously incorporate fantasy elements, systematic feedback, and competition as well as foster teamwork, cooperation, and cross-age helping.

The power of interactive systems to attract users, including young children, to invite them to "play," and to give them feedback, approximates the sort of learning process that occurs when a child learns to talk, walk, play an instrument, ride a bicycle, perfect athletic skills. O.K. Moore impressively demonstrated the power of interactive systems to teach reading and writing skills to very young children over a decade ago, but the systems on which the "talking typewriter" were based were too expensive for widespread use. New technology changes the cost factor, and makes the systems more fun to use.

Of course interactive systems can get boring, like any new toy. Variety and increasing challenge must be built into interactive computer-based activities, or they may become tedious. Apparently such electronic games as pinball and Star Trek are sufficiently challenging to become addictive to thousands of people, from high-school students to computer scientists. Surely elements of these successfully designed programs can be incorporated into electronic games for school and home use.

Computer games can simultaneously incorporate fantasy elements, systematic feedback, and competition as well as foster teamwork, cooperation, and cross-age helping.

The computer can present the "board" on which human opponents play, or the computer can become the opponent. Several people at different locations can play each other through a central computer. Games of chance, games of skill, instructional games, classic board games, mathematical recreations are already available on school computer systems (and on micros; see David Ahl's *Basic Computer Games*), although many have not yet been adapted for young children. This should be an interesting challenge for educators, programmers, and hobbyists.

Drill and practice systems. One major reason for the widespread resistance to "open" educational environments that invite student initiative and do not prescribe specific learning experiences for most of the day is that they often appear to leave mastery of basic skills to chance. Teachers in such classrooms are often overwhelmed with logistical problems as they try to interact with diverse groups of learners on an individualized basis. Electronic systems offer an ideal method of giving students interesting and challenging opportunities to consolidate skills and concepts they have acquired through concrete and active learning, and to drill rote information once the conceptual bases are understood. Examples are practicing reading skills and mathematical algorithms, learning vocabulary in a foreign language, memorizing the multiplication table. The rote information and the number of "overlearned" skills that we expect children to master in elementary school is quite finite. Surely these basic skills and concepts will be easily mastered in the future through electronic systems, perhaps even mostly at home, leaving schools to provide much more stimulating "concrete" experiences.

The elementary-grades math and reading exercises distributed by the Computer Curriculum Corporation provide an example of a first generation of computer-managed drill and practice materials. Future materials for elementary students will probably be more gamelike, more like the ingenious math games developed by the Urbana PLATO group, and they may be delivered on microcomputers or handheld calculator drill/practice devices such as the Texas Instruments Dataman™ or Speak & Spell™.

In a game we have developed on the PET, for example, children learn to identify letters of the alphabet and to match them with the appropriate keys on the keyboard by "shooting" letters as they bounce around the screen by "firing" the key corresponding to the target letter. Proper timing, estimation of ricochet angles, etc. enter into the activity, making it an interesting challenge to the entire age range from kindergarten to adults. "DART," another clever game (developed by Brad Compton, a high school student from Ann Arbor) involves practicing the arithmetic computation skills, from the "2+2" level on up through rapid estimation of products and dividends. Feedback is given as distance from the bullseye of a target, with points scored for accuracy, and an increasingly tough time limit is imposed for each "throw." The game can be played as a two person or one person activity.

The mass storage and file-handling

capabilities of the systems to which children have access will improve. This will make it possible to generate games and practice activities based on data from individual students or from large data bases provided by dictionaries, thesauruses, etc. For example, we have used a list of 20,000 words to provide entries for Hangman-type word games. We can also generate alphabetical lists of an individual student's own sight vocabulary, as it grows, and use these files to provide data for word games. The same files can be used to check student text entries for spelling; student text files can be scanned to identify new vocabulary which may be added to the student's individual list, after checking for spelling against the master dictionary list.

Tutorial systems. More ambitious and complex than games, whole tutorial "courses" are of course possible on interactive computer systems. To avoid the "brick wall" phenomenon of trapping the student in a sequence of steps, features can be built in that give the student the option of proceeding in certain directions rather than leaving the "flow" entirely to the determination of the course author and the computer. Students in curricula already developed for systems such as PLATO and TICCIT can choose to explore reference materials, to request more information about the organization of a particular discipline or domain (a "map"), request a review, a quiz, examples, easier or more difficult material, and so forth. Tutorial programs incorporated into the home or in open classrooms could permit children to master skills (such as reading music or speaking a foreign language) when they choose to do so rather than as part of a group progressing toward the same goals. A challenge to curriculum developers in early education is to relate tutorials to the concrete experiences of the child.

A tool for creative activity. Some of the most impressive work with computers and young children has been done from the perspective of making the computer into a tool for creative activity rather than a presenter of questions and answers. Alan Kay and Adele Goldberg at the Xerox Palo Alto Research Center have perhaps taken this approach the furthest, as described in Kay's September 1977 article in *Scientific American.* The Xerox group has shown that junior-high-school children can compose music, create animated cartoons, and write stories, given a powerful programming language such as their SMALLTALK language, and a computer oriented to color animations, music, and text.

The ability to edit a computer - composed product makes the computer an ideal medium for playfully creating, revising, and reshaping anything, as one would play with playdough.

Already preschool children are "doodling" electronically in color on their home TV sets with videogame joysticks. Music synthesizers have become inexpensive additions to home computer systems, musical devices useful for active exploration by young children of the principles of music theory and notation. The ability to edit a computer-composed product makes the computer an ideal medium for playfully creating, revising, and reshaping anything, as one would play with playdough. The work of Kay and Goldberg suggests the scope of what is possible. Electronic Lego blocks, i.e. computer-screen representations of three-dimensional objects and environments built up from basic geometric shapes, are being used by engineers and artists. Young children will have access to such systems, too, and new creative energies will be unleashed.

Learning the basic concepts of computer programming is in itself an exercise in creative problem-solving, in both analysis and synthesis. Seymour Papert's LOGO language, developed at MIT, is designed to introduce programming and the larger world of mathematics to children. Commands in LOGO, which can be communicated via a button box, move a "turtle" across the floor. Specific instructions may be combined into macros which can be named and called later on. The turtle leaves a physical trace as it moves. Simulations of the turtle's movements can also be done on computer screens, even on the PET in a kind of "tiny LOGO." Sophisticated programming concepts, and important mathematical ideas, are thus explored by figuring out how to get the turtle to trace certain kinds of paths.

Although not designed for young children, BASIC, the universal language of the "dinky" computer world, has been introduced to youngsters in the elementary grades in a number of settings; Bob Albrecht and others have had wide experience teaching BASIC to this age group in California, in schools and "community computing centers." The popularity of hobby and home microcomputers is obviously increasing the number of elementary school students who can modify programs or learn to write their own in BASIC. Despite objections from some quarters to BASIC's lack of power, structure, and elegance, this trend will continue until "better" languages are available on inexpensive systems.

Learning Con't.....

Computers will be used in elementary classrooms to create personal and collective information retrieval systems, as in the "computer conferencing" now done by adults. In this way computers will help children learn to be involved in collective problem-solving.

High/Scope is planning to evaluate a system in which students will share thoughts and experiences they have had during their pursuit of a plan or an idea. A computer-based activity file, fed by teachers and students, will present a rich array of suggestions for things to do and questions to investigate in the various interest centers of the room. Students will be able to share their activity files with students in other classes and even in other cities through a computer-conferencing system. Teachers will also be able to share ideas in particular areas with other teachers using similar curricular approaches. Text editor software will make it easy to revise or update a file entry, and will encourage active rewriting of rough drafts of student compositions.

As inexpensive computer systems become more capable, they will not only store activity files for classrooms or catalogs, and indexes of available print and media information for libraries; they will eventually store millions of books and periodicals, films and television programs, for instant retrieval. Computers will be super-libraries, jukeboxes for accessing the archives of civilization—unlimited resources for learning and decision-making.

Representing complex processes. Computers, even for elementary students, will provide a means for representing complex processes in order to help students discover relationships and isolate variables. Modes of representing processes include building and revising mathematical models, writing computer programs, planning a sequence of steps involved in any classroom project, simulating physical and social systems, analyzing data quantitatively.

Social studies simulations, for example, will introduce geographic and historical information, plus allowing students to encounter economic and political processes in game-like format. The logic of buying, selling, producing, investing, insuring, lending, borrowing, advertising, taxing, voting, bargaining, mediating, judging, planning transportation systems and land use, or making personal career decisions could be explored in this way.

Students at the High/Scope Elementary School are fascinated by simulated journeys across the Oregon Trails (a program developed by Dan Rawitsch of the Minnesota Educational Computing Consortium—see *Creative Computing,* May/Jun 1978). They are getting a sense of some simple economic principles by operating a computer-simulated lemonade stand (also a MECC program), and are even able to experience vicariously the process of making a soft landing on the moon while conserving a limited amount of fuel!

Not surprisingly, most of the simulations developed for school computers are designed, at this point, for use by students of high-school age or older (e.g., Ludwig Braun's Huntington simulations of physical and ecological and social systems). Given computer systems that can represent processes graphically and in "real time" rather than with successive printouts, it is just a matter of time before young children can experience systematically the operations of universes not directly accessible in the nonelectronic school environment.

Student assessment. Assessment of student progress and goals can be accomplished in open educational environments by interactive computer systems. Student writing, for example, can be entered into the computer files and analyzed for a variety of dimensions. Computers will be used to construct self-assessment quizzes for elementary-school students, just as item pools are sampled by computers at the university level now. The advantage of constructing quizzes and tests from large item pools is that it prevents the evaluation procedure from dangerously narrowing the curriculum to only those items that will be on the exam.

Since computers can keep track of student responses and modes of computer utilization, they can be enormously useful as research and evaluation tools. Learning activities that have computer-based elements may be easier to improve systematically than activities in which both processes and outcomes are less well documented.

Three Views of the Near Future

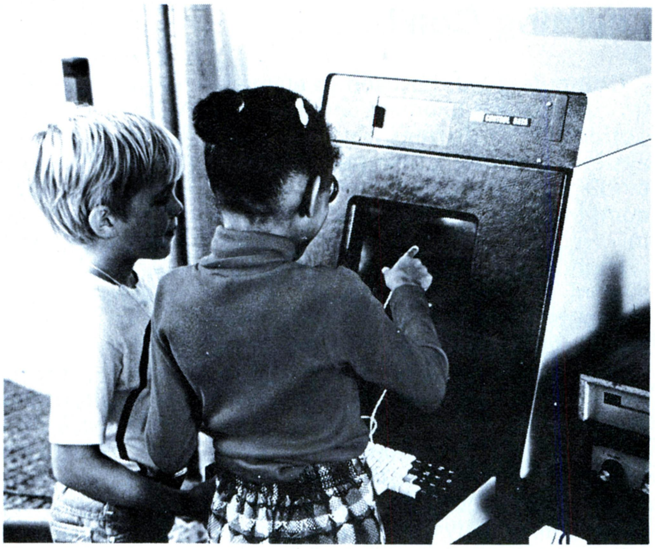
Will these various uses of computer systems change the learning and teaching process as we know it? What are the implications for families, for schools, for teachers, for students? Here are three contrasting views:

A golden age of learning. Home and school learning, according to this view of the future, will be revolutionized by the many uses of computer systems. Teachers will become liberated from uncreative tasks such as repetitious lectures and recitations, correcting tests, grading, checking workbooks and homework assignments. Teachers will welcome computers as indispensable tools of their trade, just as farmers have come to regard tractors. Students, stimulated by the power of interactive electronic systems, will master basic skills easily and joyfully. Interactive electronic systems will invite students to explore many domains of human knowledge and endeavor. Because of their interactive nature, electronic systems based on microelectronic components will advance the cause of progressive education in the Dewey and Piaget traditions, rather than remain the tools of those, often of behavioristic orientation, who believe that the ideal learning environment has goals explicitly stated by the instructor and not by the student. The individualization of learning goals, content, and methods made possible by computers will make the flexibility inherent in "open" alternative learning settings more attractive to teachers, parents, and students than at present. The widespread availability of "basic skills" programs and other educational software for home computer systems will redefine the public's expectations of school learning.

Will electronic devices replace teachers, and will classrooms be replaced by cubicles in which students interact only with machines?

Optimists see computers-on-chips making it possible through mass education for most students to achieve broad competence actively and in a developmentally appropriate manner. Inquiry, problem-solving skills, and representation will be integrated with concrete experiences via the computer. Diverse student interests, abilities, and goals will be supported. The computer will become an equalizer, in the sense that it will give previously disadvantaged youngsters access to a wide range of skills and information, plus the motivational elements (i.e., computers give immediate feedback, are nonthreatening, fun, challenging but not frustrating) to use these resources. Lifelong learning will become a reality for millions through the combination of print and video media with an interactive component which can be accessed at home as easily as anywhere else in a community or the country.

Learning that stresses student initiative and breadth of experience will



blossom, because the logistical problems confronting teachers with large classes will be solved through increased use of interactive electronic systems. One version of the golden-age scenario sees schools as institutions so substantially altered in their function by new technologies that they are ultimately transformed into learning centers operating more like libraries or museums than classrooms. *All* students will have access to tools and learning aids of all kinds, much as they do in the open-classroom environments of today.

An age of dehumanization. Perhaps a unified information/education/communications network is merely the final step toward a nightmare world of thought control. At the very least, pessimists suggest, computers will do for thinking what the automobile did for walking and television did for reading. Perhaps schools will undergo great strife over the issue of "capital intensive" vs. "labor intensive" techniques and will come to repeat the sad history of American passenger railroads, in which fights over job security and technological innovation distracted attention from the fact that the entire system was dying because of its inability to compete with alternatives.

Will electronic devices replace teachers, and will classrooms be replaced by cubicles in which students interact only with machines? Are we sure that technology will support humanistic values when so often it seems to undermine them? Will computers be used in place of experience with real people, places, and materials? television, and computers themselves and "seatwork" in schools have probably already replaced many real, direct experiences. Will computers exacerbate this trend? Will drill-and-practice and programmed CAI become the dominant formats, rather than the more open-ended applications of interactive electronic systems? Will learners be trapped in step-by-step strands, blocks, and levels, unable to pursue their own paths to their own objectives?

Instead of becoming an equalizer of class differences, electronic systems, say the pessimists, will widen class and caste barriers by giving children of affluent families access to learning resources that others cannot afford. Will children who have access to computers from the time they can sit up become a computer priesthood, leaving the computer illiterates doomed to low-prestige roles in society?

Schools as institutions have been remarkably impervious to technological change.

Business as usual. In addition to the optimists and pessimists, one comes across many educators who simply do not believe that interactive microelectronic systems will change teaching and learning significantly one way or another. They point out that computer technology and telecommunications have been around for years. Radio, Television, and computers themselves have been a fact of life for North Americans for quite a while, but so far they have brought about neither a golden age nor a 1984/Brave New World-style dystopia. Just because a new technology *could* be used to change the way people learn doesn't mean that it *will* be directly employed by the educational establishment in imaginative ways. Television is the prime case in point.

Schools as institutions have been remarkably impervious to technological change. Transportation and communications technologies have certainly affected schools, but indirectly, rather than by changing the nature of classroom learning. Even some individuals deeply involved in instructional computing believe that the computer's function in schools is to teach children to use existing computer languages and to perform calculations in science and math courses. In their view, computers are too expensive and "technical" for young children to employ, except perhaps for drill-and-practice exercises. This view accounts for the priority given to secondary schools rather than elementary schools applications in many districts.

Individuals working in the computer industry often point out that corporations and individuals with the talent and resources to produce software for educational applications will find other markets more profitable than schools. Commercial television's lack of educationally oriented programming is cited as evidence that the home market, also, is interested in entertainment rather than learning. Given instantaneous access to any page in any book in the Library of Congress, or access to any college course in the country, will the average citizen prefer to watch Celebrity Bionic Football on television? Will computers married to videodisc simply permit seven-year-olds to retrieve instantly works from the "Brady Bunch" corpus?

In the 1960's several large corporations lost gobs of money trying to market educational technology products; they may be reluctant to re-enter this market. Are the costs of computer-based systems now so much less that the wave of first attempts can now bear fruit, or are there problems

Learning Con't.....

more fundamental than economic ones? Certainly the home or personal microcomputer of today will not instantly usher in the millennium. For one thing, the microcomputer industry has major hardware and software compatibility problems. It is possible that no one will buy the hardware because of lack of applications software, and conversely no applications software will be produced because the market is too fragmented among owners of different machines speaking different computer languages and accepting different kinds of input/output devices and storage media.

Shaping the Future

Given both optimistic and pessimistic predictions about the impact of microelectronic technologies, as well as the prediction of negligible effects, how can those of us concerned with the education of young children come to terms with the potential of microelectronic systems? The assumption that makes most sense to us at the High/Scope Foundation is that the potential of these systems is as great as those promising a golden age say it is, BUT we must very purposefully work toward utilization of that potential in education.

The golden age of learning will not automatically come about. We need good R & D work among groups seeking to marry computer systems and student-initiated learning. We need to evaluate the utilization of computer systems in learning settings other than school classrooms, settings such as homes and community computer-learning centers. And we need to establish information networks to keep one another informed about the computer applications being developed all over the world.

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A Drop-In Computer Center For High-School Students

Karl Zinn

Ed Herstein, interviewed here by Karl Zinn, teaches math and computer studies at Community High School in Ann Arbor, Michigan.

The interview was sparked by Ed's paper at the November 1977 NAUCAL conference, "Microcomputers Put More 'Byte' Into Teaching." One of the predictions in Ed's presentation: "The time is not far off when highly sophisticated software will make it possible for personal microcomputers to be sensitive to many of an individual's educational needs and to provide the resources necessary to meet them."

Karl: I enjoyed your speech at the NAUCAL Conference last Fall. I was particularly intrigued with your description of a drop-in computer center for elementary and junior high-school students. Creative Computing readers will be interested in the specifics of that program.

Ed: Basically, we have two types of activities. We have a series of eight-week computer courses that meet one afternoon a week from 4:00 to 5:30 P.M. Then we have a drop-in time from 5:30 to 9:30 P.M. when kids can sign up to use the computer hardware on their own.

Karl: Your primary objective is to teach students to program?

Ed: In a narrow sense, yes. Most of the class time is spent teaching the kids Basic. This gives the classes a goal, and the students are highly motivated by looking forward to doing their own programming.

Karl: Do kids as young as 12 and 13 become competent programmers?

Ed: That was probably the biggest surprise I got when I began to teach the course. I've had seventh and eighth graders who within a year not only had become excellent Basic programmers but had also learned Fortran and assembly language. Programs written by former students have been added to the utility libraries on systems in our area. My youngest student took the course when he was in third grade. He was certainly an exceptional kid, but I've become convinced that if the interest level is high enough, age and educational experience aren't major factors in teaching programming fundamentals.

Karl: I notice that a number of your students have gotten jobs as programmers.

Ed: The University of Michigan and a few area computer businesses have provided part-time and summer employment for several former students. Generally both parties benefit. The students gain income and experience; the companies get very sharp programmers for much less than they would have to pay comparably talented professionals.

It's very satisfying to feel that these kids are acquiring marketable skills, but I don't expect that every student will become a professional programmer. I see teaching a computer language primarily as a means to reaching a broader goal: computer literacy.

Too many adults believe that computers are huge, intricate, very expensive pieces of machinery understood only by an elite few.

Karl: Define that more specifically for us.

Ed: I feel it is vitally important that kids — who are going to be surrounded by computers in the very near future — have an opportunity to interact with them in a friendly, supportive environment. I hope my course will teach kids enough so that they can feel comfortable around computers, so they can feel that computers are tools that they can control. Too many adults believe that computers are huge, intricate, very expensive pieces of machinery understood only by an elite few. The kids in my courses don't have these fears. If some of them also benefit directly from their programming skills, that's frosting on the cake.

Karl: Did you have some help starting these after school activities?

Ed: Yes. The program began in November 1975 when Nan Hodges, then vice president of the Ann Arbor Association for Gifted Children, came to my school seeking help in establishing intellectually challenging activities for early adolescents. We came up with the idea of the after school computer program.

Karl: Who paid the costs of the program?

Ed: The first class had a $15 tuition charge that was used to pay my salary. The hardware the same equipment I used for my regular high-school classes. The association paid my school for paper and other supplies. We originally anticipated just one eight-week class so we expected that the expenses would be fairly small.

Karl: And now you're in your third year of the program with kids of all kinds. What happened?

Ed: We found that we had a tiger by the tail. As people learned about the course we started getting calls requesting enrollment in a second session. When the first course neared completion most of the kids wanted to

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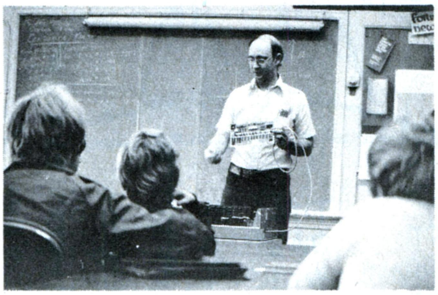
Karl Zinn, Center for Research on Learning and Teaching, University of Michigan, 109 E. Madison, Ann Arbor, MI 48109.

Drop-In Center Con't...

do more. By the beginning of the second year we had convinced the public-school administration that we were fulfilling an important function and they began to cover all the expenses.

Karl: Has the administration also purchased all the hardware for the drop-in center?

Ed: They've purchased some of it. Our two CRTs and two hardcopy terminals were purchased for the high school, but we've earned most of the microcomputer equipment ourselves.



Karl: Tell us how you earned equipment.

Ed: Much of it has been donated by parents or companies who wanted to support and improve our program. We've also earned some memory boards and other components by assembling microcomputer kits for area firms. This has really worked out well for us since it gives the kids a lot of direct experience with hardware that would not otherwise be available. Finally, we've raised money to purchase equipment through a variety of means including selling dinners during drop-in, selling computer generated posters and biorhythm charts at school fairs, and renting out terminals.

Since microcomputers are going to be far more prevalent than big computers, especially for home use, they're more relevant to study.

Karl: Students take terminals home?

Ed: Yes. I think it's very important that people who are learning about computers spend enough time on terminals so that they can get comfortable, try out new things, explore the system, and have sufficient opportunity to overcome the occasional failures they will experience. Computer hardware is too scarce a resource to lock up whenever schools are closed. We try to buy reasonably portable equipment, and we've never had a problem with kids abusing the hardware. Sometimes parents will complain when their home phone is tied up with an acoustic coupler for hours at a time, but I'd like to think that it doesn't hurt to promote a little computer literacy among the parents anyway.

Karl: What timesharing systems are available to your students?

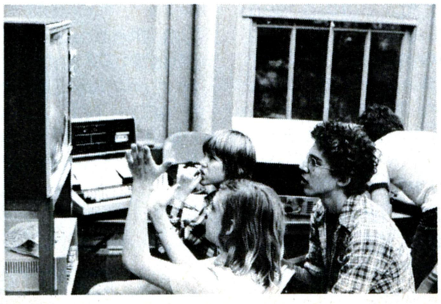
Ed: The only system for which we have a formal arrangement is the HP-2000F at the Washtenaw Intermediate School District. Since this system is limited to Basic, we've worked out temporary access to a number of much more powerful computers in the area. We've had good success giving kids experience with many different languages and systems.

Karl: How would you compare timesharing with microcomputers for teaching a class such as yours?

Ed: I'm very enthused about micros. With a classroom microcomputer I can actually show students what a computer looks like. I can point out the CPU and memory, even teach binary, octal, and hex arithmetic using the front panel. The kids have a chance to learn something about hardware and electronics. Since microcomputers are going to be far more prevalent than big computers, especially for home use, they're more relevant to study. They're also more versatile. We've got joysticks, a music board, and a couple of exciting video display boards plugged into our micros.

Karl: But aren't many of these peripherals primarily game-playing devices?

Ed: That's one of the best things about them. Computer games are great educational tools. They teach kids a lot about computers. For example, a sophisticated Star Trek game can make a computer appear very smart, but if it can't process a command that's misspelled, a kid immediately realizes there are serious limitations on the nature of its intelligence. Most games are educational to play, and they generate a great deal of motivation to program. In fact most of the programming problems we discuss in the afterschool course are related to games.



Karl: With the introduction of the $600 personal computers I expect interest in computers to accelerate rapidly. How would you recommend a person approach starting a program like yours?

Ed: The most important attributes are enthusiasm and a willingness to explore and experiment in terms of both hardware and classroom technique. Second, I think the role of the teacher in an introductory computer course is basically that of a facilitator, one who provides resources, ideas, answers to questions, and encouragement. There's very little need for the more traditional tasks of lecturing, testing, assigning, and grading. Finally, the teacher must be comfortable with the idea that he or she will often know much less about a given aspect of computing than his or her students do. It's neither necessary nor desirable to limit students' areas of exploration and knowledge to those of the teacher.

Karl: I think it's safe to say that many of your views — game-playing, renting out terminals, avoiding traditional teaching techniques — would not be accepted in most public schools. How can one demonstrate success?

Ed: The success of my courses and drop-in center has been recognized by some rather traditional people. Some quantitative measures include the number of useful programs my students have developed, the many students who have found employment in the computer field, and the continuing growth of enrollments in the afterschool classes. But the measure that means the most to me is the intensity of interest, concentration, and often delight on the faces of the students in the program. Visitors see that at the drop-in center. Ninety percent of the problems of education would be solved if we could do as well throughout the curriculum; and someday soon, using computers, I hope we will. ■

10 New Books From The Creative Computing Bookservice

BASIC and the Personal Computer

Dwyer and *Critchfield.* This book will get you involved with personal computing, writing programs and expanding the use of your computer by showing the great diversity of applications possible on any microcomputer. One of the most comprehensive presentations of BASIC ever. As a text or addition to your personal library, this book will tell you all you ever wanted to know about BASIC. 350 pp. $12.95 [9F].

My Computer Likes Me

This entertaining self-teaching workbook introduces the BASIC language to young or old. Problems and examples are drawn from population problems and demographic data. A nice, easy start into BASIC. Large format. 60 pp. $2.00 [8K].

Computers, Computers, Computers In Fiction And In Verse

D. Van Tassel, Editor. This collection of stories, commentaries and poems project the reader into a world where lifestyles are dominated by the computer to an extent far greater than they are by the telephone today. By revealing reactions and effects, the stories offer the reader insight into what is a potential reality. Cleverly-written, this book should entertain anyone who is aware of the computer's impact on society. Includes work by such distinguished writers as Gordon R. Dickson, Art Buchwald, Michael Shaara and Bob and Ray. 192 pp. $6.95 [9X].

Sixty Challenging Problems with BASIC Solution

Donald Spencer. This book is a vehicle for computer programmers to measure their skills against some interesting problems that lend themselves to computer solution. It includes games, puzzles, mathematical recreations and science and business problems — some hard, some easy. The book will compliment any computer-oriented course in secondary school or college. BASIC program solutions included. 80 pp. $6.95 [9W].

Modern Digital Communications

E.J. Ross. This volume thoroughly explains how mass communications systems used by banks, businesses, airlines, news services, hotels and others operate. A must for anyone interested in computerized communications, including computer hobbyists and amateur radio operators. 304 pp. $6.95 [7V].

Problems For Computer Solution

Steve Rogowski. The Student Edition is designed to encourage research and preliminary investigation on the part of the student. The problems are ordered by subject and can be expanded or shortened. Mathematical problems that have never been solved are also posed to challenge and sharpen the student's awareness. 98 pp. $3.95 [9Z]. Also available is the Teacher's Edition which contains solutions, programs and analysis of the problems. 271 pp. $9.95 [9Y]. Both books are highly recommended for any high school or college computer-oriented course.

Games With The Pocket Calculator

Sivasailam Thiagarajan and Harold Stolovitch. A big step beyond tricks and puzzles with the hand calculator, the two dozen games of chance and strategy in this clever new book involve two or more players in conflict and competition. A single inexpensive four-banger is all you need to play. Large format. 55 pp. $2.00 [8H].

Beginner's Guide To Microprocessors

Charles M. Gilmore. No background in electronics is necessary to understand this book. It was written for those with no prior knowledge whatsoever of microprocessors or personal computing. Gilmore takes you from what a microprocessor is, how it works and what it's used for to how they're programmed to perform desired functions in microwave ovens, TV games, calculators, etc. 175 pp. $5.95 [7U].

The Little Book of BASIC Style: How To Write a Program You Can Read

John M. Nevison. Learn how to write better, easy-to-follow programs with Nevison's rules of style and turn out legible, correct programs. Two hours of BASIC programming is all that is necessary to profit by this book. Concepts of problem-solving and structured programming are included. 160 pp. $5.95 [9V].

The Home Computer Revolution

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Conference on Intelligent Videodiscs

Watsonville, CA. — The first days of December were beautiful and balmy among the sand dunes of Monterey Bay, but there were 48 men and women there who barely had time to notice; they were attending an invitation-only conference, sponsored by the National Science Foundation, to assess the educational prospects for a device that may do for electronic signals what Gutenberg's press did for text.

The device under discussion combines the talents of the computer and the videodisc. The videodisc is an extension of long-playing audio disc technology into the domain of television and digital computers. A number of videodisc systems have been demonstrated, but the ones of greatest interest to this group use a low-power laser to read information from a plastic disc, spinning at 1,800 revolutions per minute. Such an optically-read disc can be made to "freeze" on any frame, and it can show motion sequences in slow motion, either forward or backward.

Only a fourth of the conferees were videodisc specialists; the remainder were experts in computer hardware, computer programming, graphics displays and instructional technology. The other disciplines were there because of the very attractive educational prospects for a marriage of videodisc and computer technologies. Any of the 54,000 video frames on a half-hour disc can be quickly accessed. Computer programs can also be stored on the videodisc and transferred into the computer's memory. The computer can quickly change from one segment to another, reducing the need for very large amounts of expensive memory.

An intelligent videodisc of this type, combining computer and videodisc capabilities, has a large number of potential applications; it could augment present day computer-assisted learning systems that do not offer full multimedia capabilities. It could rapidly retrieve information from large stable databases.

The conference began with three background papers given by the codirectors: "Trends in Personal Computing" by Arthur Luehrmann of Lawrence Hall of Science, Berkeley; "Requirements for Educational Computing" by Alfred Bork of University of California, Irvine; and "Videodiscs Beyond Entertainment" by Edward W. Schneider of Brigham Young University. Subsequent general discussion of costs, time-frames and potential markets led to the formation of small study groups, to develop plausible strategies for the development of both the technologies and the markets.

The study groups did not see educational applications as dependent on the mass marketing of home videodisc players. Instead, the groups saw a gradually evolving market, pioneered by government-funded development and demonstration projects. These projects would enhance this new system's penetration of traditionally high-cost areas of training and education, such as military, industrial, and medical applications, as well as courses in technical schools and universities.

Other strategies were proposed; for example, piggy-backing on related special applications such as information retrieval in laboratories or developing new organizational mechanisms to share the development costs and to promote the effective use of such materials.

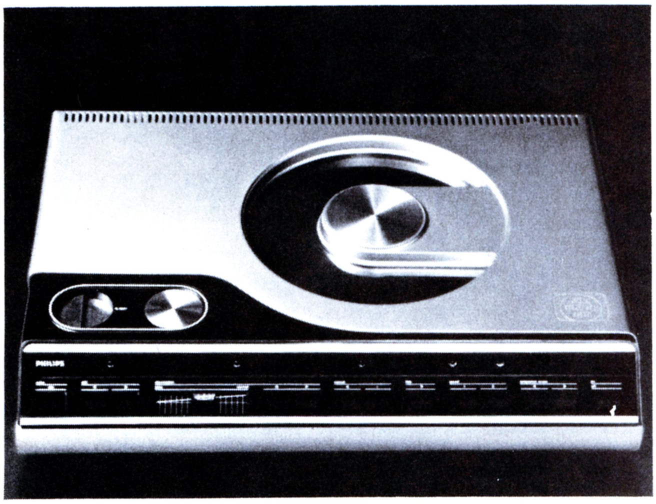
After three days of probing, most conferees, bolstered by the converging opinions of their colleagues; became "guardedly optimistic" about the market prospects of intelligent videodiscs, but they were uniformly enthusiastic about the capabilities that emerge when video and digital technologies are combined.

For more information, write: Alfred Bork, Physics Department, University of California, Irvine, California 92717, (714) 833-6911.

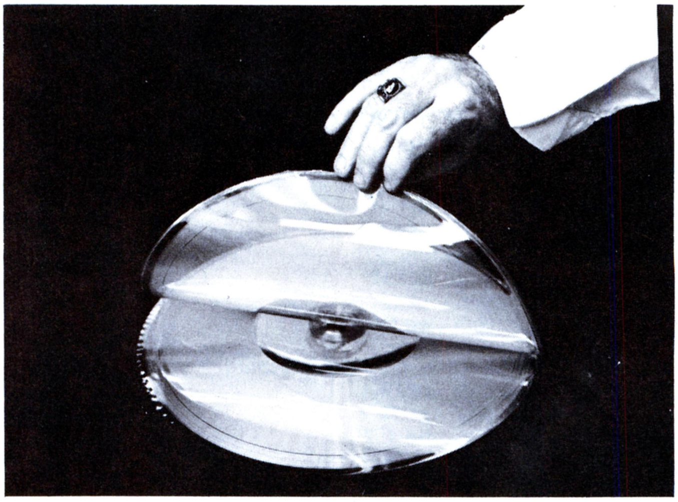
IBM Videodisc?

This item from the June 1978 issue of *Consumer Electronics:*

Is IBM getting set to enter the consumer video disc market? Or is all the apparent developmental disc work going on at the giant computer manufacturer just one of numerous projects it undertakes to cover all conceivable bases. "We don't disclose any information on products that are still in development," a spokesman said. That response seems to indicate something is going on, though in the past IBM has responded similarly to questions on other products (home VTR and personal computer systems, to name two), and it may simply indicate that IBM is working on just about everything electronic. The latest IBM disc rumors erupted early last month, and many in the industry are convinced the firm has stepped up developmental work over the past six months., "They seem to be working on just about every conceivable consumer electronic product," one observer noted, "so it may mean nothing." But he added: "I am getting a lot of telephone calls all of a sudden asking me what's going on. I wish I knew."
[The possibilities of the video disc as a digital storage medium have been discussed at length in *Creative Computing* (March/April 1976) so IBM may well be looking at this aspect of the medium. I wish I knew too. - DHA]



Philips/MCA Videodisc Player.



The master videodisc is cut by laser.

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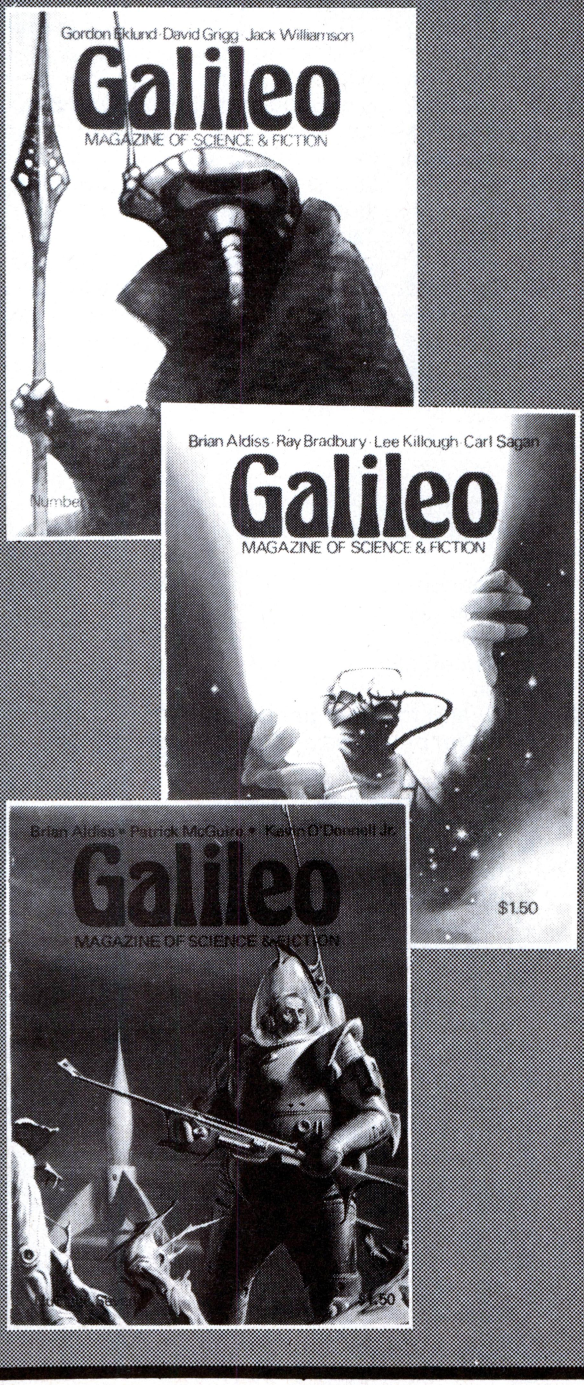
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Considerations in Buying A Personal Computer

What, Which, When, How Much?

by Karl L. Zinn

Many people ask me for advice on whether to buy a personal computer now or wait for the price to go down. Some are asking which one to buy. A few recognize that the inexpensive machines available today won't do everything one might be led to believe from the advertising. But then, these portable, low-cost, convenient, and personal computers will do a lot of things for which we presently turn to very expensive machines. This outline is a first attempt to assemble a checklist of considerations. Of course, the entries need elaboration, and they tend to interact.

(I would appreciate questions, comments and suggestions which will help elaborate this checklist for use by teachers. Call (313) 763-4410 or write me at CRLT, Univ. of Michigan, 109 East Madison Street, Ann Arbor, MI 48104.)

A Note to Educators

With the prices of microcomputer systems coming down so rapidly, and with the availability of integrated, high-quality system software, it is now possible for many educators to consider the use of micros to supplement or to replace the use of a larger timesharing system. Nevertheless many educators who would like to begin using microcomputers find themselves in a quandary, not having the technical expertise to select a complete microcomputer system. The following list, compiled by Karl Zinn, should at least help these educators get an idea of what to look for. My own experience in talking to educators who want to use microcomputers in high school indicates that three other things are of special importance:

1. Compatibility between BASIC used on the microcomputer and the timesharing system. Obviously if the BASICs are similar, it won't be necessary to develop new course materials, programs, etc.
2. The microcomputer should have an integrated package of system software which can be used by novices, not just computer freaks. In other words, it should be very easy to bring up BASIC (possibly by typing "BASIC," or just turning the power on). If the system has several different peripherals (such as a CRT, printer, etc.) it should be possible to direct output to a particular device without going into the assembly language I/O routines. One should also be aware that programming special-purpose I/O devices such as music boards, speech synthesis and recognition units, and some graphics interfaces often requires linking BASIC to assembly language subroutines.
3. Quality of the construction of the microcomputer is very important. Fewer components are better. — Steve North

1) For what purposes? Priorities? Distribution of uses?
- entertainment (Who are the users?)
  - ages
  - interests
- education (What kind of learning?)
  - general literacy about computers
  - computer programming
  - computer applications
  - incidental aid in study of other subjects
  - other?
- scientific and creative work (How serious?)
  - modeling a process
  - simulation
  - literary
  - graphics
  - music
  - other?
- personal or professional or small business
  - information handling (records, correspondence)
  - finances (checking, budgeting, . . .)
  - other
- other uses?

2) With what capabilities? Options? Peripherals?
- processor speed
- storage size and access
- programming languages
- application packages
- keyboards
- printer quality and speed
- printer quality and speed
- graphics display
- graphics input
- audio input
- speech output
- music output
- communication
  - other small machines
  - large machines (systems)

3) Which kind or type or style?
- kits
- components
- peripherals
- portability
- expandability
- other

4) When, and for what period of use?
- watch for predicted and dramatic changes in:
  - price
  - capability
  - other?
- begin now to gain experience
  - trade up later
  - early experience worthwhile
- other considerations
  - . . .

5) How much?
- total outlay
  - initial
  - later additions
- amortization
  - actual life
  - period of preferred use
  - on service contract
  - carry in service as needed
  - by individual
- maintenance
- tax deduction
  - professional
  - educational
  - gift
  - other
- other considerations?

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A Computer Activity for Building a Linear Model of Data

by Kenneth J. Travers

Let us suppose that in mathematics class we wish to build a model of the relationship between two sets of data, for example, between the height and weight of the members of the school football team. Hypothetical data will do for purposes of illustration, but students will undoubtedly prefer to gather their own, "real live" data.

Suppose further that we want a *linear* model of the data. This paper will describe such an activity in mathematical model building. While the techniques of fitting a line to a set of data (techniques known formally as "regression analysis") are commonplace in college level courses, what is described here is easily accessible, with the help of a computer to take care of the messy computation involved, to freshman algebra classes in high school. One natural place for considering this topic is when the class is studying the slope-intercept form of an equation for a straight line.

A linear model for a set of data

A linear model may be expressed algebraically as:

$$Y = mX + b$$

In terms of our original problem, the model is interpreted, "Given a student with height X, what is his weight Y?"

We have already encountered a fundamental problem. The real world does not conform to this mathematical rule! But, we are not dismayed to find that we cannot *exactly* predict a person's weight, given his height. We will be satisfied with a "good" prediction. (A very important part of this entire activity is the consideration of what "good" means. More about that later.) A more usual (and realistic) way to express a linear model is therefore:

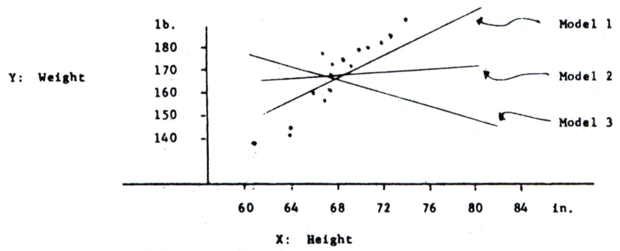
$$Y' = mX + b \qquad \text{(I)}$$

where Y ′ indicates an estimated value of Y. The coefficient m is the slope of the line and b is the Y-value when the line crosses the Y-axis.

Searching for the "best" model

Let us assume that the data for which we are trying to build a model are graphed in Figure 1. But as Figure 1 suggests, there are many linear models which could be chosen. However, recalling that a straight line is determined by one point on the line, and the slope at that point, if we locate *one* point on the desired line, we can vary the slope as we search for the "best" line.

FIGURE 1: WHICH LINE IS THE BEST MODEL FOR THE DATA?



Now let us see if we can locate one point on the line. If we knew nothing about the relationship between the height and weight, what would be a reasonable way to estimate how they relate? We do this informally when we describe the school football team with the remark, "They're about five-foot-ten and weigh 190 pounds." What we are saying is that for a mean (average) height there corresponds a mean weight. Algebraically, we are saying that

$$\bar{Y} = m\bar{X} + b \qquad \text{(II)}$$

TABLE 1: PREDICTED VALUES (Y ′) AND ERROR OF PREDICTION (Y − Y ′) FOR LINES HAVING VARIOUS SLOPES AND PASSING THROUGH ($\bar{X}$, $\bar{Y}$) = (52.33, 154.67).

SLOPE	X	Y	Y ′	Y − Y ′	(Y − Y ′)²	Mean Error	RMS Error
1.0	50	140	152.3	− 12.3	152.1	8.17	8.81
	45	152	147.3	4.6	21.7		
	62	172	164.3	7.6	58.7		
1.5	50	140	151.2	− 11.2	124.7	7.44	8.21
	45	152	143.6	8.3	69.4		
	62	172	169.2	2.8	8.0		
2.0	50	140	150.0	− 10.0	100.0	8.00	9.09
	45	152	140.0	12.0	144.0		
	62	172	174.0	− 2.0	4.0		

Note: Only three pairs of data are used in order to simplify the method.

To illustrate the idea of "best fit" we will use the simplified set of data in Table 1. We assume that the line we are looking for goes through ($\bar{X}$,$\bar{Y}$) which we see from Table 1 is the point (52.33, 154.67). Now suppose we have a line with slope m = 1.0. By equation (II), we can find b, the Y intercept.

$$b = \bar{Y} - m\bar{X} = 154.67 - (1)(52.33) = 102.34$$

and the equation of this particular line is $Y_1' = 1 \cdot X + 102.34$ (III) where the subscript of Y ′ indicates this is our first prediction line attempted.

Using (III), for each of the three X values given in Table 3, a Y ′ value can be calculated. Also, the "error of prediction," the difference between each predicted Y ′ and the corresponding actual value of Y can be found as shown in Table 1.

What is meant by "best model"?

A criterion for the "best" model now emerges. The best model is the one which minimizes the error of prediction of the Y values.

Table 1 is of help in locating the best model for our trial data. Notice, for example, that for a line with a slope of 1.0, the mean error of prediction (ignoring signs) is $\frac{|-12.3| + |4.6| + |7.6|}{3} = \frac{24.5}{3} = 8.2$. (Also notice, that within rounding error, the sum of the errors, taking account of signs, is zero.)

Another way of viewing the goodness of fit of a linear model to the data is to take the square root of the mean of the squared errors. That is, for slope = 1.0

$$\text{Error} = \sqrt{\frac{(-12.3)^2 + (4.6)^2 + (7.6)^2}{3}} = 8.81$$

This quantity is very important in more advanced statistical work, and has the name "root mean square error" or more simply, "RMS error".

Table 2 summarizes both the mean error and the root mean square error for values of the slope of the linear model in the interval from 1.0 to 2.0. Notice that as the slope of the line increases from 1.0 to 2.0, the error measures first decrease, then increase again, indicating that the slope of the "best" linear model for the data is somewhere between 1.0 and 2.0.

TABLE 2: SUMMARY OF ERRORS OF PREDICTION FOR LINES OF VARIOUS SLOPES (SIMPLIFIED DATA OF TABLE 1)

Slope	Mean Error	RMS Error
1.0	8.22	8.81
1.2	7.91	8.39
1.4	7.60	8.21
1.6	7.29	8.27
1.8	7.02	8.57
2.0	8.00	9.09

Kenneth J. Travers, University of Illinois, Urbana, IL 61801.

Although we have a choice as to whether we use mean error or RMS error as our criterion of goodness of fit, advanced statistics points clearly to the desirability of using RMS error and the result is called a "least squares best fit" model.

Table 2 magnifies the interval from 1.0 to 2.0 and points to values between 1.2 and 1.6 as containing the desired slope. A further magnification as given in Table 3 produces a slope of 1.45 having a corresponding RMS error of 8.20. Actually, by a formula from more advanced statistics, the slope of the "least squares best fit" line is found to be 1.44979 for the data of Table 1 (See footnote on following page for formula). All of the calculations needed for this "trap and magnify" procedure are provided by the BASIC computer program in the appendix.

TABLE 3: "TRAPPING" THE SLOPE OF THE BEST MODEL (SIMPLIFIED DATA OF TABLE 1)

Slope	RMS Error
1.20	8.39
1.25	8.32
1.30	8.27
1.35	8.23
1.40	8.21
1.45	8.20
1.50	8.21
1.55	8.23
1.60	8.27

TABLE 4: SUMMARY STATISTICS AND ERRORS OF PREDICTION FOR LINES OF VARIOUS SLOPES FOR 17 PAIRS OF DATA
$(\bar{X}, \bar{Y}) = (68.76, 165.65)$

Slope	RMS Error
1.0	10.54
2.0	7.65
3.0	5.76
3.40	5.5436
3.42	5.5430
3.44	5.5434
3.5	5.55
4.0	5.94

We now repeat the procedure for the 17 pairs of data plotted in Figure 1. Table 4 gives the summary statistics and the RMS error associated with slopes from m = 1.0 to m = 4.0. The least squares best fit line has a slope close to 3.42[1]. Using equation II and the values for $\bar{X}$ and $\bar{Y}$, we obtain the "best" linear model as

$$Y' = 3.42\,X - 69.54.$$

Finally, we apply the model. Suppose a male high school senior is 65 inches tall. What is his predicted weight?

$$\begin{aligned} Y' &= 3.42\,X - 69.54 \\ &= (3.42)\quad(65)\quad - 69.54 \\ &= 152.8 \text{ pounds} \end{aligned}$$

---

[1] The formulas used to compute the statistics (covariance, standard deviation, and so forth) may be found in standard statistics texts such as Edwards or Freund. (Note: Our formulas for variance and covariance are biased estimators.)

The slope of the lease squares line of best fit for Y predicted from X may be computed from the formula

$$\text{Slope} = \frac{\text{covariance}\,(X,Y)}{(\text{standard deviation of } X)^2} = \frac{46.916}{(3.703)^2} = 3.422$$

for the data of Table 4. Hence, the search procedure, which gave a slope of 3.42, was remarkably accurate.

REFERENCES

EDWARDS, ALLEN L. *Statistical Methods.* Second Edition. Holt, Rinehart and Winston, New York, 1967.

FREUND, JOHN E. *Mathematical Statistics.* Prentice-Hall, Englewood Cliffs, New Jersey, 1971.

APPENDIX
BASIC PROGRAM TO FIND BEST MODEL

```
10 DIM X(50),Y(50)
20 LET S1=S2=S5=S6=S7=0
30 READ N
40 DATA 17
50 FØR I=1 TØ N
60 READ X(I),Y(I)
70 LET S1=S1+X(I)
80 LET S2=S2+Y(I)
90 LET S5=S5+X(I)*X(I)
100 LET S6=S6+Y(I)*Y(I)
110 LET S7=S7+X(I)*Y(I)
120 NEXT I
130 PRINT "YØU HAVE ";N;"PAIRS ØF DATA"
140 PRINT "MEAN VALUE FØR X= ";S1/N
150 PRINT "MEAN VALUE FØR Y= ";S2/N
160 LET E=S5/N-S1*S1/(N*N)
170 PRINT "STANDARD DEVIATIØN ØF X IS";SQR(E)
180 PRINT "STANDARD DEVIATIØN ØF Y IS";SQR(S6/N-S2*S2/(N*N))
190 LET C=S7/N-S1*S2/(N*N)
200 PRINT "CØVARIANCE FØR X AND Y IS";C
210 PRINT "*******SEARCH FØR BEST MØDEL*********"
220 PRINT "WHAT SLØPE DØ YØU WANT TØ TRY ",
230 INPUT M
240 LET B=S2/N-M*S1/N
250 PRINT "THIS LINE HAS EQTN Y'=";M;"X +";B
260 LET S3=0
270 LET S4=0
280 PRINT "X","Y","Y'","Y-Y'","(Y-Y)↑2"
290 FØR I=1 TØ N
300 LET Y1=M*X(I)+B
310 LET D1=Y(I)-Y1
320 PRINT X(I),Y(I),Y1,D1,D1*D1
330 LET S3=S3+ABS(D1)
340 LET S4=S4+D1*D1
350 NEXT I
360 PRINT "MEAN ERRØR= ";S3/N
370 PRINT "RMS ERRØR= ";SQR(S4/N)
380 PRINT
390 GØTØ 220
400 DATA 61,140,64,141,64,144,66,158,67,156
410 DATA 67,174,68,160,68,164,68,170,69,172
420 DATA 70,170,71,175,72,170,72,174,73,176
430 DATA 74,180,75,192
440 END
```

SAMPLE OUTPUT

```
YØU HAVE  17 PAIRS ØF DATA
MEAN VALUE FØR X=  68.7647
MEAN VALUE FØR Y=  165.647
STANDARD DEVIATIØN ØF X IS 3.70261
STANDARD DEVIATIØN ØF Y IS 13.8307
CØVARIANCE FØR X AND Y IS 46.917
*******SEARCH FØR BEST MØDEL*********
WHAT SLØPE DØ YØU WANT TØ TRY               ?1
THIS LINE HAS EQTN Y'= 1 X + 96.8824
X               Y               Y'              Y-Y'            (Y-Y)↑2
 61              140             157.882        -17.8824         319.779
 64              141             160.882        -19.8824         395.308
 64              144             160.882        -16.8824         285.014
 66              158             162.882        -4.88235         23.8374
 67              156             163.882        -7.88235         62.1315
 67              174             163.882         10.1176         102.367
 68              160             164.882        -4.88235         23.8374
 68              164             164.882        -0.882353        0.778547
 68              170             164.882         5.11765         26.1903
 69              172             165.882         6.11765         37.4256
 70              170             166.882         3.11765         9.71972
 71              175             167.882         7.11765         50.6609
 72              170             168.882         1.11765         1.24914
 72              174             168.882         5.11765         26.1903
 73              176             169.882         6.11765         37.4256
 74              180             170.882         9.11765         83.1315
 75              192             171.882         20.1176         404.72
MEAN ERRØR=  8.609
RMS ERRØR=  10.5434
```

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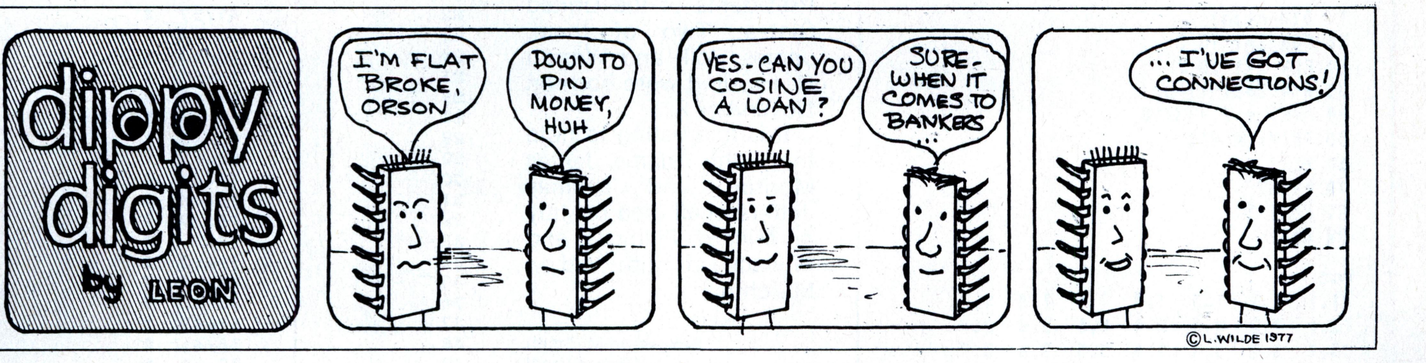

dippy digits
by LEON
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DOWN TO PIN MONEY, HUH
YES-CAN YOU COSINE A LOAN?
SURE- WHEN IT COMES TO BANKERS...
... I'VE GOT CONNECTIONS!
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short programs.....

Subscripts

If you have a version of BASIC which does not allow double subscripts, have you looked wistfully at all the interesting games and programs that contain lines like:

100 A(I,J) = I + J/10...?

Well, the situation really is far from hopeless. As a simple example, suppose you wanted to create and print a table of numbers. You want the table to have five rows and seven columns, and each entry in the table is to be a decimal number with the row number on the left of the decimal point and the column number on the right. Here is one way to do it *with* double subscripts:

```
20 FOR I = 1 TO 5
30 FOR J = 1 TO 7
40 A(I.J) = I + J/10
50 PRINT A(I,J);
60 NEXT
70 PRINT
80 NEXT I
90 END
```

```
20 FOR I=1 TO 5
30 FOR J=1 TO 7
40 A(I,J)=I+J/10
50 PRINT A(I,J);
60 NEXT J
70 PRINT
80 NEXT I
90 END

run
 1.1  1.2  1.3  1.4  1.5  1.6  1.7
 2.1  2.2  2.3  2.4  2.5  2.6  2.7
 3.1  3.2  3.3  3.4  3.5  3.6  3.7
 4.1  4.2  4.3  4.4  4.5  4.6  4.7
 5.1  5.2  5.3  5.4  5.5  5.6  5.7
```

```
10 DIM A(35)
20 FOR I=1 TO 5
30 FOR J=1 TO 7
35 N = 7*(I-1)+J
40 A(N) = I + J/10
50 PRINT A(N);
60 NEXT J
70 PRINT
80 NEXT I
90 END

run
 1.1  1.2  1.3  1.4  1.5  1.6  1.7
 2.1  2.2  2.3  2.4  2.5  2.6  2.7
 3.1  3.2  3.3  3.4  3.5  3.6  3.7
 4.1  4.2  4.3  4.4  4.5  4.6  4.7
 5.1  5.2  5.3  5.4  5.5  5.6  5.7
```

Can we achieve the same result without the use of double subscripts? Happily, the answer is yes. Add the following line:

35 N = 7*(I-1)+J

and change lines 40 and 50 to:

40 A(N)=1 + J/10

50 PRINT A(N);

The secret is at line 35. In general, to imitate the variable A(I,J), use A(C*(I-1)+J) where C is the number of *columns* in your array.

It's that simple.

With this technique, for instance, I have been able to translate Gregory Yob's "HUNT THE WUMPUS" into Radio Shack's *Level I* BASIC, which allows only single subscripts.

Well, what are you waiting for? Get out those back issues of *Creative Computing* that had all the games you *thought* you couldn't program.

Now you can.

James Garon
Math Dept.
Calif. State University
Fullerton, CA 92634

Common Birthdays

```
10 PRINT "NUMBER OF    PROBABILITY THAT AT LEAST"
20 PRINT "PEOPLE       TWO HAVE SAME BIRTHDAY"
30 PRINT "---------    -------------------------"
40 Q=364/365
60 FOR N=2 TO 40
70 P=100*(1-Q)
80 PRINT "  ";N;TAB(20);INT(P*100+.5)/100;TAB(28);"%"
90 Q=Q*(365-N)/365
100 NEXT N
110 END
                    RUN
                    NUMBER OF   PROBABILITY THAT AT LEAST
                    PEOPLE      TWO HAVE SAME BIRTHDAY
                    ---------   -------------------------
                      2                   .27    %
                      3                   .82    %
                      4                  1.64    %
                      5                  2.71    %
                      6                  4.05    %
                      7                  5.62    %
                      8                  7.43    %
                      9                  9.46    %
                      10                 11.69   %
                      11                 14.11   %
                      12                 16.7    %
                      13                 19.44   %
                      14                 22.31   %
                      15                 25.29   %
                      16                 28.36   %
                      17                 31.5    %
                      18                 34.69   %
                      19                 37.91   %
                      20                 41.14   %
                      21                 44.37   %
                      22                 47.57   %
                      23                 50.73   %
                      24                 53.83   %
                      25                 56.87   %
                      26                 59.82   %
                      27                 62.69   %
                      28                 65.45   %
                      29                 68.1    %
                      30                 70.63   %
                      31                 73.05   %
                      32                 75.33   %
                      33                 77.5    %
                      34                 79.53   %
                      35                 81.44   %
                      36                 83.22   %
                      37                 84.87   %
                      38                 86.41   %
                      39                 87.82   %
                      40                 89.12   %
```

In a group of ten randomly selected people, there is about a 12% chance that two of them share a common birthday.

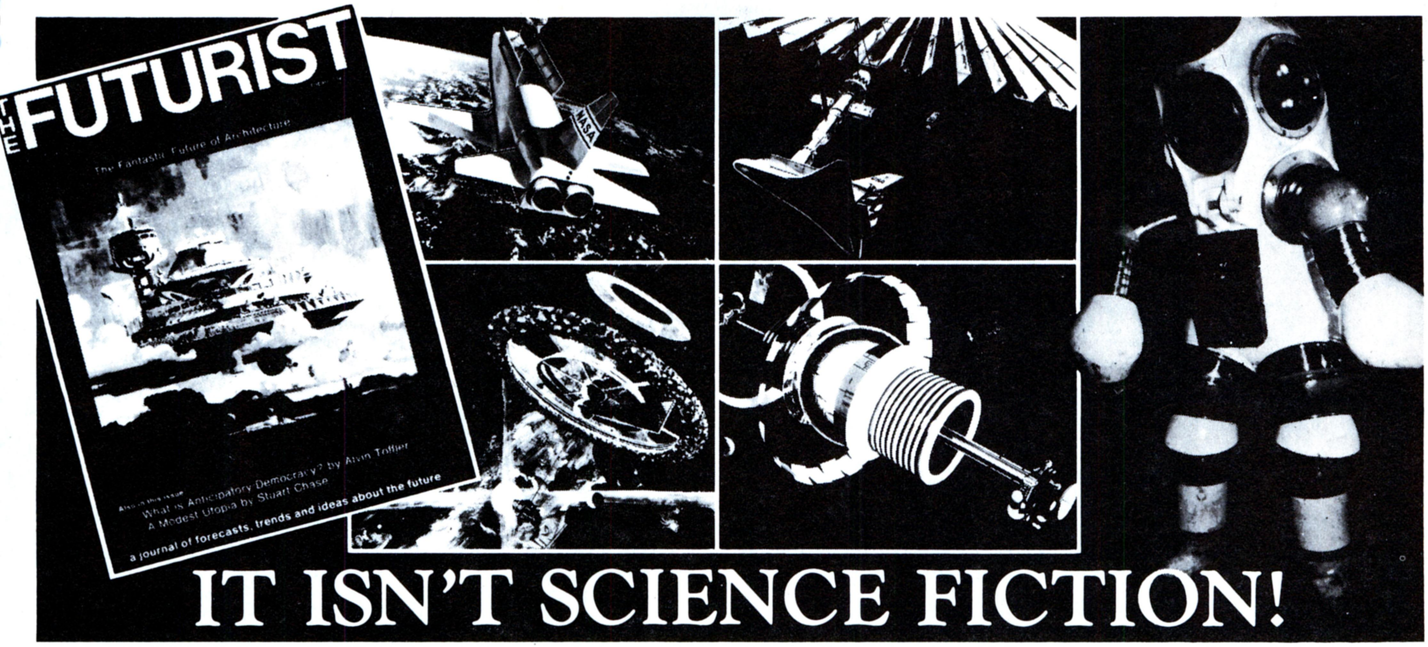
With 23 people, the probability is slightly greater than 50%.

With 40 people, the probability is about 89%.

Consider the set of all Presidents of the United States. Two of them, James Polk and Warren G. Harding were born on November 2.

It is interesting to note that John Adams, James Monroe, and Thomas Jefferson all died on July 4. Millard Fillmore and William Taft both died on March 8.

Sanderson M. Smith
Cate School
Carpinteria, CA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CIRCLE 171 ON READER SERVICE CARD

Freedom and the Computer

Jon R. Welton

[Pub. note: The author presents a picture of a regimented society that many believe could be brought about by computers and other currently available machinery. Although he states that "Americans' compulsive desire for freedom will continue to frustrate any plan to substitute efficiency for liberty," nevertheless many of the people who make our laws, form our opinions and publish our newspapers, also believe in many or all of the facets of such regimentation. As "insiders," we ought to be aware that such views are much more widely held than our own.]

Is it now possible to control the lives of a group of people through the use of computers and related technology that is currently available or will be available in the foreseeable future? Certainly. Today there are scientific marvels that were undreamed of a generation ago. These present day miracles can be used for the good of us all or for the power and aggrandizement of a privileged few.

Technological Advances

Science and technology have exploded in the last seventy-five years, taking man from the back of a horse to the surface of the moon. This is especially dramatic in the fields of communications and computer technology. Human speech was first radioed across the Atlantic in 1915 from the U.S. navy station at Arlington, Virginia to U.S. radio-telephone engineers atop the Eiffel Tower in Paris, France. Today one hundred and seven countries, territories and possessions on six continents are using communication satellite services, enabling more than one billion people — one of every four persons on earth — to see an international event on television as it happens. And they can view these events on their own personal pocket size television sets which are currently available on the market.

About thirty years ago, J. Presper Eckert, Jr., and John W. Mauchly built the world's first electronic digital computer, ENIAC (Electronic Numerical Integrator and Computer) which weighed thirty tons and ran on 19,000 vacuum tubes. Today a computer on a chip about .16 inches by .12 inches can just about match ENIAC's computational power. ENIAC could perform three hundred multiplications per second. Today's computers are learning to talk, read commands directly from the human brain, play good chess — although not Grand Master level — compose music and control complex business, scientific and governmental processes. Furthermore, computers owned by insurance companies, credit businesses, government agencies and marketing firms contain all sorts of information on practically every man, woman and child in the United States. The computer has invaded the fields of science, technology, business and government to the point that it is meaningless to describe an activity as computerized. In 1972 there was one computer for every 2400 people in the U.S. and the computer population explosion has not yet abated.

Scientific developments and discoveries continue to increase the capabilities of computers and communications equipment. Out of the new field of fiber optics, for example, comes the development of special glass fibers that will be used to enable computers to operate ten times faster than they do now. These fibers also will make it possible to transmit the entire thirty volume *Encyclopedia Britannica* in a tenth of a second.

For Good or Evil?

Man can use this technology to help cure the ills of the world. But man's recorded history is an endless parade of cruelty, barbarism and selfishness with an occasional good deed thrown in to relieve the monotony. Of course, man has advanced over the centuries. No longer is it state policy to break men on the rack, boil them in oil or feed them to the lions. It wasn't long ago, however, that people were burned in ovens as a matter of state policy. For whatever reasons, real or imagined, there apparently will always be those who know the "truth," whatever that is, and in pursuit of this "truth" will stop at nothing to bend others to their will.

Is it now possible to control the lives of a group of people through the use of computers and related technology that is currently available or will be available in the foreseeable future? Certainly.

Jon R. Welton, 3521 Winifred, Ft. Worth, TX 76133.

The Corporate Model

What kind of control could be used to manipulate the destinies of the masses? Given the tools at hand, it seems that a society and its people might be managed much like a giant corporation with budgets and performance standards and with attendant rewards and punishments.

Personnel files could be maintained on everyone from birth to death. Such files might contain records of personal health, military service, criminal activity, education, financial transactions, licenses, psychological tests, membership in organizations, and physical identification characteristics such as scars, abnormalities, finger prints and voice patterns.

Virtually all human activity could be touched by the computer. Food could be ordered through a computer terminal in the home. Reading material such as newspapers, magazines, and books could be fed from the library through the computer to the home terminal where copies would be made merely by pressing a button on the TV set and reproducing those pages of interest. If one wished to travel outside of his city, he could be required to register his location with the computer. Of course his eating, reading and travel habits would then be a matter of record in the computer.

Houses and apartments could be assigned by the state based upon one's position in the society, family size and length of time one has waited for a home. But a home is more than a roof held up by walls; it is a mate and often children. The state could help in finding a mate through a computerized dating service. Even though there might be little state influence regarding mate selection other than computerized introduction, there quite possibly would be state control of reproduction. Genetic and health profiles of individuals and their families might be used to determine if couples should be authorized to produce children. Perhaps selective sterilization would be performed prior to puberty, precluding the need to seek such authorization.

Improved Health Care

Computerized health history has its good side in that doctors could have instantaneous access to a patient's records. Furthermore, personal health transmitters may be carried by those who require them and vital data could then be monitored by the computer. Menus can be printed by the computer for diabetics and others who must have special diets. Nutrition needs can be matched to locally available foods to present choices for the patient.

Since good health is enhanced by exercise, the state might require exercise programs that would be closely watched by the computer. Reservations for tennis, handball, racquet ball, squash, golf, etc. could be computerized. Demands for courts, alleys, diamonds, greens and fields might also be computer monitored and construction programs could be scheduled to meet those demands.

Sports would not be the only form of recreation. Present research and development in holography makes 3D movies a reality, and work with liquid crystals sensitive to electricity make wall-size TV a coming reality. Vacations at parks and seashores may be computer scheduled. Facilities would not be overcrowded or overused because access to them could be managed. Vacations might be scheduled much like airlines presently schedule passenger travel.

Little Personal Privacy

Travel in general would not be overly restricted as long as the computer knows where an individual is located. If the computer has received no input within a week regarding at least one activity such as work, mandatory sports, vacation, etc. a search could be conducted. All family members, work associates and exercise companions could be contacted. Also, the missing person's voice pattern may be fed into the communications system and if that pattern appears, its source could be pinpointed.

Where it may be virtually impossible to hide one's identity and location from the computer, it may be difficult to lie to it as well. The same device that is used to monitor vital signs could also serve as a lie detector. In that task it may be aided by a voice-stress analyzer that could determine when a lie is spoken.

From School to the Job

Speaking to the computer may be commonplace. There are computers now able to handle limited discourse. Particularly in education and training, the computer could interact verbally with the students in programmed learning. Of course an individual's speed and ability to learn becomes a permanent record. Lectures, reading assignments and even experiments might be carried on by and with the computer. Children sitting in front of TV screens could travel with their eyes and ears anywhere in the world. They may learn such new skills as three-dimensional drawing through the use of computer graphics.

Sometime before completing schooling, the computer could help the student choose a career. The student would talk to the computer, feeding in important details about his or her goals, needs and values. The computer would then weigh the information it receives from the student with personal information already on file and with the needs of the state. Then it could present the student with sets of alternatives compatible with his or her own requirements and the requirements of the state. When the student finishes school, the job awaits.

Performance on the job may be watched and recorded by the computer. The worker's home, pay, vacation and life style in general could be influenced by job performance as recorded. In case a job is lost because of obsolescence, automation or even incompetence, the computer may assist in retraining and, if necessary, in relocating the displaced worker.

From the job, to the home, in the school, on the playing field, into the grave and practically everywhere else, the individual could be guided, monitored, scheduled, programmed, trained and helped by and through the computer. Also, people could be collectively controlled.

Performance of the whole economy may be computer guided. Economic activity could be determined and directed by a state budget. The preparation of this budget would be based upon timely information which would be vast in volume and detail. Presently, large corporations such as International Telephone and Telegraph Corporation (ITT) budget and direct the activities of vast international organizations that are larger and more complex than many small nations. For example, ITT's revenues in 1975 were $14 billion. Ireland's Gross National Product was $7.8 billion that same year.

Americans Distrust Computer Control

Will a computer controlled society emerge in the U.S.? Recent events in the last decade or so point to a reluctance on the part of conservatives and liberals alike to trust computerized government.

The first attempt to use a computerized system for more efficient government was in 1965, when the Social Science Research Council recommended that the Federal Bureau of the Budget create a national center for socioeconomic data. After all, important new Federal responsibilities for urban renewal, health, anti-poverty, education and civil rights made amalgamation of statistical data essential. These data could be drawn from the Census Bureau, Bureau of Labor Statistics, Social Security Administration and the Internal Revenue Service.

From 1966 to 1968 two congressional subcommittees studied the proposal and concluded that there was always the possibility that those managing the center or those obtaining access to it could connect it with an intelligence system and obtain a comprehensive print-out of all information stored about a target individual. Moreover, they believed that such a system could have enormous detrimental effects on the citizens' privacy and could lead to a concentration of power in the hands of Federal officials who might use the data for intelligence purposes.

Meanwhile, publications such as the liberal *Washington Post* and the conservative *U.S. News and World Report* were warning their readers of the "Big Brother" possibilities of the center. The data center was debated at national meetings of groups from the American Bar Association to the Joint Computer Conference. The center was short-circuited before it was even plugged in.

Government Amasses Information

The Federal government today does have, however, files containing varied information about many U.S. citizens. For example: the Internal Revenue Service and the Social Security Administration carry income and employment data; the Veterans Administration has military service data; the Bureau of Alcohol, Tobacco and Firearms has data on gun collections; the Clerk of Congress or the Federal Elections Commission records political contributions over $100; the Coast Guard maintains boat registrations; the Defense Intelligence Agency has data on executives in companies with military contracts; the Federal Aviation Agency has data on applicants for and holders of private-plane licenses; the Federal Communications Commission has files on ham operators and boat-radio license holders; the Federal Trade Commission has files on many top executives; the Health, Education and Welfare Department has financial records of parents whose children are seeking student loans; the Justice Department has data on families of juveniles facing drug or similar charges in court; the Securities and Exchange Commission has information on corporate insiders; the Small Business Administration maintains loan applications; the State Department keeps data regarding passports and the Treasury Department records banking transactions involving more than $10,000.

> **Where it may be virtually impossible to hide one's identity and location from the computer, it may be difficult to lie to it as well.**

Legal Safeguards

With the proliferation of government files, there is an accompanying growth of legal safeguards. The Freedom of Information Act, as amended in 1974, and the Privacy Act of 1974 permit individuals to write for copies of personal records collected by federal agencies, to correct any inaccuracies in those records and, within limits, to control disclosure of them to other agencies. The Tax Reform Act of 1976 prohibits the Internal Revenue Service from disclosing personal files to the White House and the rest of government unless the requests are in writing and signed by the President, his delegate or the top official of the requesting agency. Additionally, IRS must give notice to an individual prior to getting personal records held by that person's bank, accountant, lawyer, stockbroker, credit union, credit card issuer or savings and loan company. The taxpayer can direct that his records not be disclosed except by court order.

Freedom Before Efficiency

Along with increased computer sophistication and data handling capacity and with rapid growth of communication networks, there is a growing paranoia about government abuse of individual freedom. Americans' compulsive desire for freedom will continue to frustrate any plan to substitute efficiency for liberty. ■

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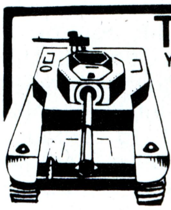
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DISTRIBUTED PROCESSING DYNAMITE!

. . . Not Necessarily!!

James C. Meehan, Jr.

The system-design form widely referred to as "distributed processing" is fast becoming state-of-the-art design in many data-processing circles. For purposes of discussion here, we can define the concept as follows:

> "Distributed processing is the removing of some functions from the traditional large-scale 'host' processor, and distributing those functions into a network of mini- and micro-processors. These functions include data-base management, data manipulation and communications control."

Distributed processing is one of the results of successful manufacture of multi-function, mini- and micro-processors. It allows many applications to become economically and operationally feasible where they previously would have expired on the drawing board. No longer are "mega-buck" investments necessary to support on-line, user-oriented systems. Reduced communication-line costs, speedy response, improved reliability and recovery, are all very real benefits of distributed processing. The end result of all this is to allow us to bring the power of data processing back under the control of the end-user. Because of this very reason, if sufficient attention is not paid to the role of that user, we are apt to construct sophisticated, reliable, instant-response failures!

The End-User in Mind

It is fairly evident that an on-line system has to be designed and implemented with the end-user in mind in order to be successful. The user's role as a provider and recipient of data is well accepted; less widely accepted is the concept that the user is also a processor. As a processor, the user is an integral node in the system and all user functions must be designed and tested as part of the total system. The system (or more accurately the computer subsystem) must not be completed and presented to the user as a *fait accompli*. In parallel to the machine subsystem development, a personnel subsystem must be developed. This personnel subsystem must be developed in the same manner as the computer subsystem; defined, designed, implemented, tested and converted. The personnel subsystem that is no more than final documentation of the machine subsystem is a sign of a successful failure. Many times the developers of machine subsystems are the same persons charged with development of the personnel subsystems. While this is not inherently bad, nor are the skills mutually exclusive, it is indeed rare to find a person who can switch between two such demanding tasks and do both well. Personnel subsystem development has lagged behind computer subsystem development as a discipline, and still needs to be recognized as being at least equally important.

Tomorrow's Job

Another concept of personnel/machine interface design that is often overlooked is that the person doing the user job today is not automatically qualified to do the job tomorrow with an on-line system. Ability to read and write English (or any language) and the ability to discern the difference between symbols is *not* sufficient. Persons dealing with a new machine subsystem may need varying levels of skills and knowledge before they are really qualified to interface successfully with the machine subsystem. It is part of the personnel subsystem developers charge to define and provide for any training necessary for successful system implementation. Again, computer experts may not be qualified in designing and developing this training, even though they may have very detailed knowledge of the workings of the computer subsystem.

Test and Evaluate

A third concept of development of adequate personnel subsystems in distributed networks is that they must be tested and evaluated as much as the machine subsystem. This means following much the same steps as for a machine subsystem; developing a test plan, defining test criteria, providing test data, conducting and evaluating the test, etc. However, the problems encountered in adequately testing a personnel subsystem are different and more complex than a machine subsystem. It is costly, for starters; not only do you have to find and schedule people in a large enough sample, but you are usually faced with maintaining an acceptable level of output in their normal assignments. Testing on an off-shift or on weekends, a technique used

---

The personnel subsystem that is no more than final documentation of the machine subsystem is a sign of a successful failure.

James C. Meehan, Jr., 245 State St., Room 701, Boston, MA 02109.

in machine testing, can't be used here for obvious reasons. Another problem is establishing a base level of knowledge to train from; some incorrect conclusions drawn here could result in over- or undertrained people. Other problems arise in evaluation, subjective criteria, preconditioning of test subjects, and a great many more complications not found in machine testing. Personnel subsystem testing is time-consuming, costly and difficult to evaluate, which may be why it is so often neglected. However, it is the only way to have some assurance the system will work as designed from a "total system" point of view.

Distributed processing is a viable and powerful design alternative, and a major vehicle to taking advantage of the recent leaps in mini- and microprocessor development.

Unique Pitfalls?

Are all these pitfalls unique to systems designed for distributed processing? Are these not present in all systems, especially on-line systems? They are *not* unique to distributed processing, they *are* present in all system development efforts. The point of this article is that they have become much more crucial because via distributed processing, we are able to implement user-oriented systems on a significantly broader base than ever before, at greatly reduced hardware and software development cost. Some specific reasons why this personnel subsystem attention is more critical are:

- The terminal operator is likely to be located some distance from system support staff.
- The terminal operator is more apt to be a non-computer oriented person, as opposed to a keypunch operator or a payroll clerk.
- The terminal operators main-line responsibility may be far greater than simply terminal functions.
- The operator may have to interface with customers simultaneously with the machine subsystem.

Because distributed processing enables bringing computer resources back into the hands of the system user in an interactive mode, it also puts increased pressure on the total system developer to ensure that the user can in fact use the system. In companies with small to medium size (10 to 50 persons permanent systems development staff) data systems organizations, it may be more difficult to maintain qualified personnel subsystem developers. For these companies, it may be less costly in the long run to contract out for personnel subsystem services and maintain a minimal staff for changes and on-going training. Companies with larger data systems development staff should have resident personnel subsystem expertise to develop and support the manual part of the systems.

Distributed processing is indeed a viable and powerful design alternative, and a major vehicle to taking advantage of the recent leaps in mini- and micro-processor development. However, it is most important that we recognize the danger in installing user-oriented systems via distributed processing if we do not focus sufficient attention on the role of that user. ■

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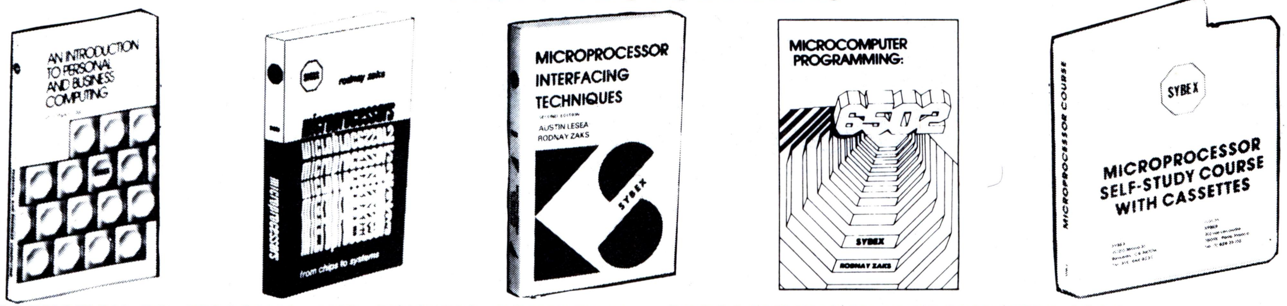
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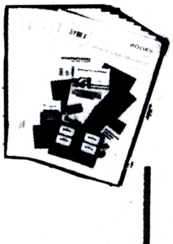
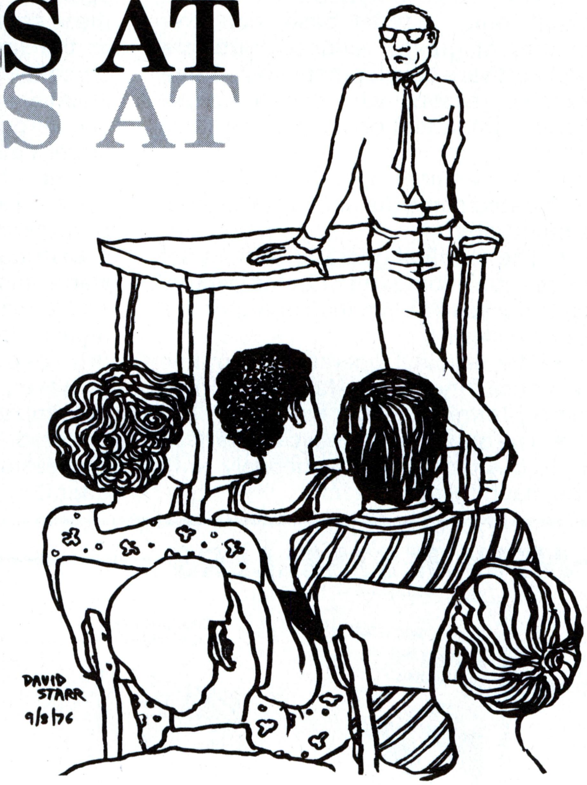


CIRCLE 123 ON READER SERVICE CARD

YOU CAN'T THINK IN TWO PLACES AT ONCE

YOU CAN'T THINK IN TWO PLACES AT ONCE



Sam Crowe

Everybody puts out vibrations, man. I mean everybody. Most people radiate confused vibes, full of rejection and fear. Catonic people radiate vibes that are ice cold. A few, very few, people radiate good happy vibes that make people want to be around them. Some actors can throw those good vibes out even when they are on film. They call it 'presence' but it's the same thing.

The thing I'm getting at, what I'm trying to really put down is the absolute inevitable truth, everybody has vibes. Everybody, no exceptions.

Yet, here was a man, seemingly human, who had no vibes. Standing there and talking to me and the rest of the class and no vibes were coming across. It made goose pimples on me. Everybody in class was uneasy even if they didn't know why. Me, I was a senior, but I was old for my years. I'd come to this school from poverty so deep that I could read vibes. When you're a little kid and you go places a little kid isn't supposed to go and are up when you aren't supposed to be up, you learn to read people's vibes or you don't survive.

Mr. Nielsen was our business teacher and up until today he'd had vibes like everybody else. Now he stood like a piece of stone in front of the class and his mouth moved and words came out but nobody was catching what he was putting down. It was like a T.V. set talking with no pictures. You hear the words but you keep looking for the picture and losing track of the words.

Donna Dee Folsom stood up and grabbed her books. I could see her hands trembling. She told Mr. Nielsen that she was sick and had to go see the nurse. He nodded and Donna went through the door like a scared cat and every girl in the class got up and followed her.

Mr. Nielsen sagged back and sat on the front of his desk and ran his hand across his forehead. He looked at me and the boys that were left and his eyes lost their blankness for an instant and cold sweat broke out on his face and he was sending vibes out like a person with a nervous breakdown. Then his eyes shut down again. Everybody shuffled around in their seats waiting for somebody to make a break.

Binky Jones started the exodus. He just got up and walked out real cool. Binky was always a cool guy. He didn't know what was going on but he knew he wasn't having any part of it.

Mr. Nielsen watched them file out. Not a single emotion crossed his face. It was as if he were watching a bug crawl across the floor not because he had any interest in the bug but because it just happened to be handy for his eyes to focus on.

I stayed in my seat, fidgeting under the stare of those blank eyes. I stayed because those crazy vibes he'd sent out for a second had been screaming for help. Like the school psycho-man had told me, I had empathy. Something was eating Mr. Nielsen's soul.

"That's the third class, today, that's walked out on me." Mr. Nielsen said, "Why did you stay, Byran? Better yet, why did the rest go?"

I got up and walked up close to Nielsen. It wasn't easy. Like the feeling you get when you are going swimming for the first time in the year and your toes touch the cold water. Your body says stop, don't go in. Your mind says everything will be all right once you get into the water. Getting close to a person without vibes was like that. It was like being close to a dead person. But undertakers get used to that, I suppose. Anyhow, the longer I stayed around Nielsen, the less bothered I was.

"Mr. Nielsen, You've always been straight with me and you helped me get that job last summer, so I couldn't walk away from you. I don't turn my back on people unless they turn theirs on me." I said.

"That doesn't tell me why I'm suddenly so bad a teacher that the students walk out of my classes, Bryan."

Up real close to him, I could almost feel his vibes. It was like they were there but buried under ice. Somewhere deep inside him, his soul was still kicking. It was fighting whatever was eating it. His soul did not want to die.

"Mr. Nielsen, my mother always told me that my grandfather back in Louisana, was a Mojo man. She said the biggest white men in the parrish took off their hats to my grandfather. The school psychiatrist here, told me I had empathy. My mother says it's the Mojo in me. I never told anybody this before because they would just laugh. I know what's wrong with you, Mr. Nielsen. Something or somebody is eating your soul. They're making a zombie out of you. All the stories are wrong. The old witchmen didn't make zombies out of dead people, they made them out of living people."

Mr. Nielsen passed a shaking hand across his grey tinted forehead. "That sounds like a lot of trash, Bryan." He clumsily thumped his chest and an expression of agony crossed his face. "But something in here tells me you are right."

He turned his agonized face to me again, "Can you help me?"

His vibes screamed at me with the words, Help me, help me.

It was almost time for the bell to change classes.

"I'll try to help you, Mr. Nielsen. I don't know much but I'll try. Is there someplace we can go? It's almost time for the bell and we've got to do a lot of rapping because right now I have no idea what to do or tell you."

"Let's go to my office in the data center. Only the computer operator will be there now and he'll be out by the console."

We walked through the empty halls to his office. I wondered where all my classmates had gone without hall passes. The monitors must have busted some of them. I felt like I was walking along by a robot and when we sat down in his office it seemed like he was remoter than before. He didn't seem to have much time left.

He sat looking through the glass into the computer room for a long moment. We heard the bells ringing. Mrs. Thorpe was going to be angry with me for missing biology but it couldn't be helped. I shuffled my shoes on the floor until Neilsen looked at me, his face was very strained.

"This seems sillier and sillier, but I know there's something basically wrong with me. Somehow I know that a doctor couldn't help me. So do your Mojo thing, Bryan." He said, without hope.

"Sir, you were okay yesterday, so whatever or whoever got to you did it last night or yesterday after school. Did you make a Mojo man or a witch mad last night or yesterday after school? Did you insult a gypsy or call on the devil?" I asked, "Did you disappoint someone in love or laugh at someone's far out beliefs?"

"I didn't do any of those things yesterday, Bryan. I don't understand why I'm letting you do this either, such questions. Yesterday I stayed here, right here and in the computer room until late at night."

"Where were you at midnight, Mr. Nielsen? It isn't called the witching hour for nothing."

"I was here until one o'clock in the morning."

"When was the last time that you had your hair cut, Mr. Nielsen?"

"I haven't had it cut in months. I've been getting it styled. You know I try to maintain a rapport with my students."

"What do you do with the parings when you cut your toenails or your fingernails?"

"Flush them down the garbage disposal."

"Man, we're not getting anywhere." I said unhappily. I sat and stared out the window at the computer. The little lights on the console flashed at me. The thing almost seemed like it was sending out vibes at me. I began talking mostly for my own benefit, trying to think out loud.

"There has to be a pattern. A ju-ju doll with your hair and your nails, or a photograph of you. A good one that has some of your vibes. There has to be something that is a pattern of you."

I stared in silence at the computer for a while. It blinked and blinked.

"They ever shut that thing off?" I asked.

"No, we use it sixteen hours a day and a service bureau uses it from midnight to eight and on weekends. That's how the school was able to afford such a modern system, by sharing the cost." He answered.

"What were you working on last night?"

"On a software interruptions procedure for the supervisor of the operating system."

"What is that in, everyday English?"

"Well, the supervisor program is online, that is, it is running all the time. It handles all of the other work. It loads in programs and handles interruptions to the job stream. It assigns input-output functions and a great many other things. I didn't like the way it handled things so I patched it to do it my way."

"So now it thinks like you do?"

"More or less."

I got up and went into the computer room. Mr. Nielsen just sat behind his desk and followed me with his blank eyes. I stopped by the man who was running the machine.

"Is this the brains of the thing?" I asked and pointed at the unit with the typewriter thing attached and with all the little blinking lights.

He said, "Yes, that's the CPU, the central processing unit."

"What does that red pull knob do?" I asked, pointing to a knob marked emergency.

"That shuts everything down at once and scrambles the machines brains." The guy laughed, "Take about two days to get it running again."

I reached out and yanked the knob. The guy running things just sat in stunned silence, watching the lights go out.

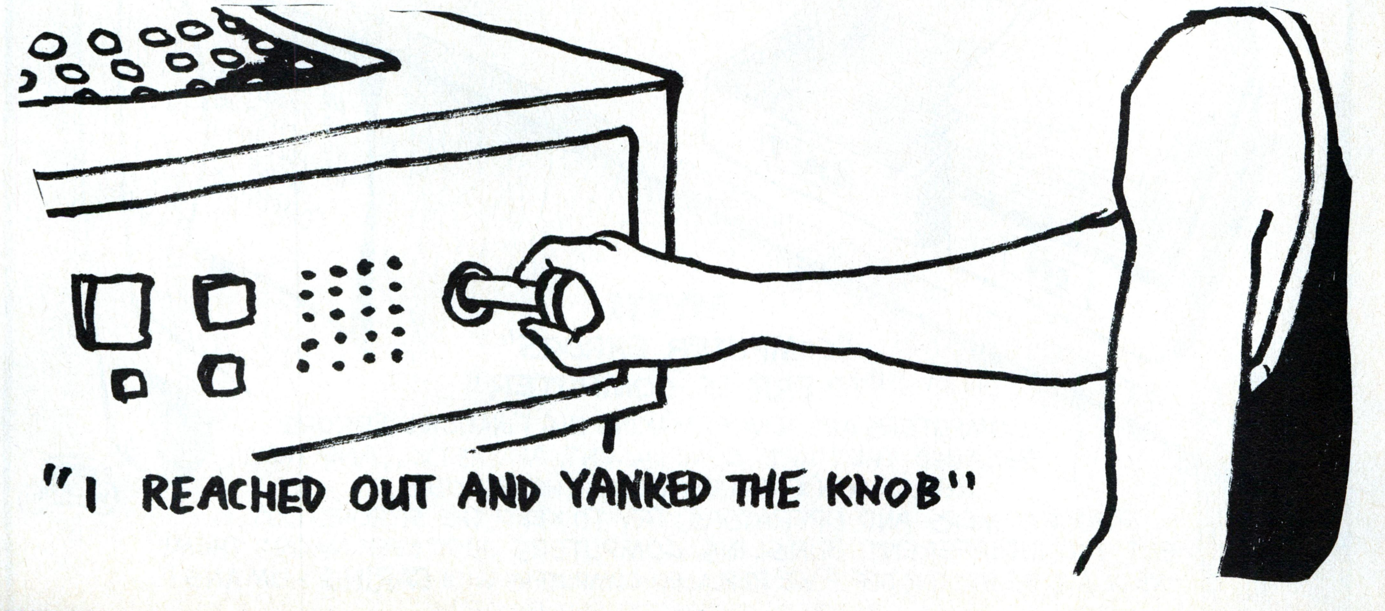
Mr. Nielsen came out of his office shouting mad. He was putting out a ton of good old human vibes. I figured that once I got him calmed down, I'd have two days to convince him that the machine was eating his soul. It was going to be rough but I would do it somehow.

"Why in the world did you do that, Bryan!" Mr. Nielsen yelled.

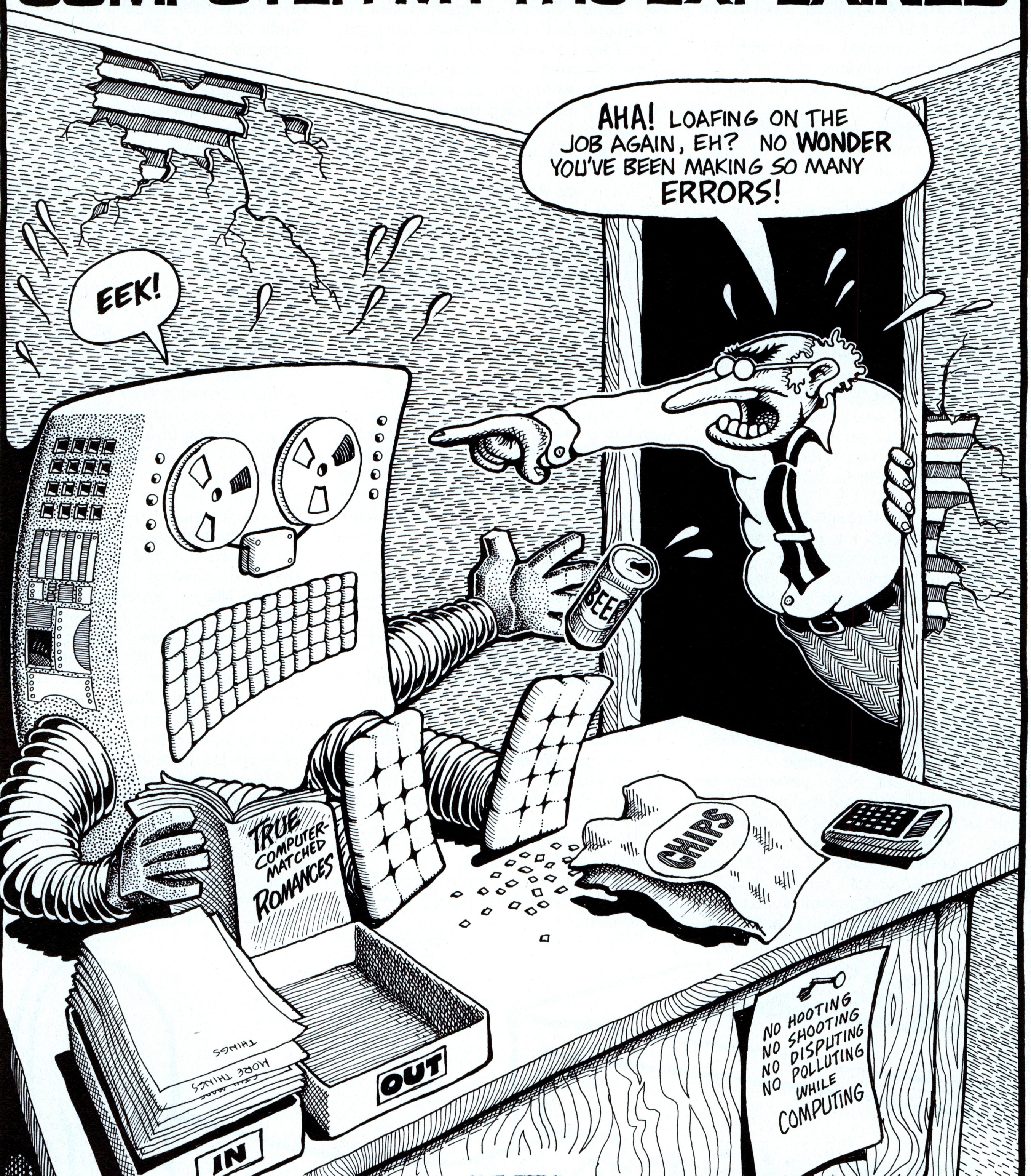
"Welcome back, Mr. Nielsen." I said quietly.

He stopped shouting and gave me a strange look. Then he pointed at the machine. "That did it?"

"Yes sir." I said, "International Business Mojo." ■


"I REACHED OUT AND YANKED THE KNOB"

COMPUTER MYTHS EXPLAINED

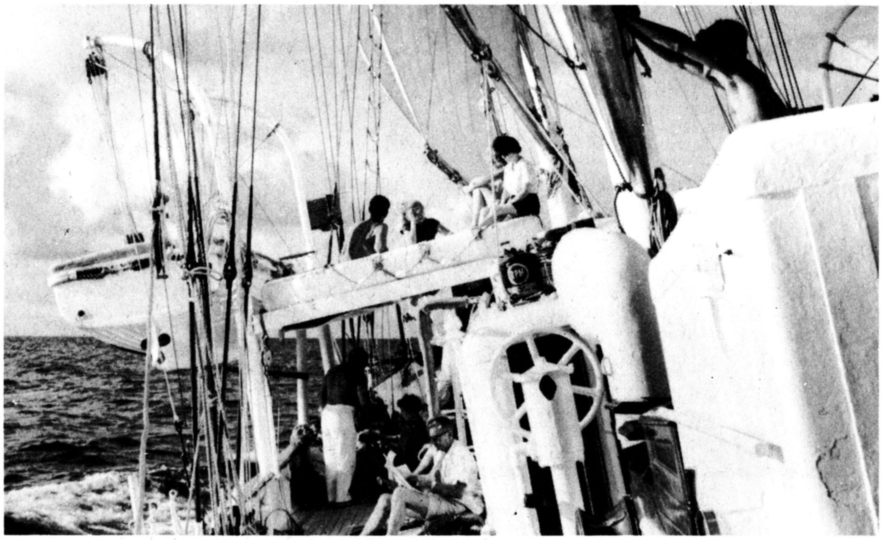

AHA! LOAFING ON THE JOB AGAIN, EH? NO **WONDER** YOU'VE BEEN MAKING SO MANY **ERRORS!**
EEK!
BEER
TRUE COMPUTER-MATCHED ROMANCES
CHIPS
THINGS
MORE THINGS
IN
OUT
NO HOOTING
NO SHOOTING
NO DISPUTING
NO POLLUTING
WHILE
COMPUTING

MYTH
"COMPUTER ERRORS"
OR
"TO ERR IS COMPUTER"

COMPUTERS ARE ALWAYS MAKING BIG FINANCIAL ERRORS BECAUSE THEY ARE COMPLACENT, APATHETIC, AND THEY REALLY DON'T CARE ABOUT THEIR JOBS.
PROGRAMMERS AND OPERATORS TRY TO KEEP THE ERRORS OUT, BUT THE INDIFFERENT, BUNGLING COMPUTERS JUST KEEP MAKING THEM!
WE'DE ALL BE BETTER OFF IF WE REPLACED COMPUTERS WITH **CARING** HUMANS!
(LIKE IN THE GOOD OLD DAYS!)

MONTE WOLVERTON

Take off your shoes.



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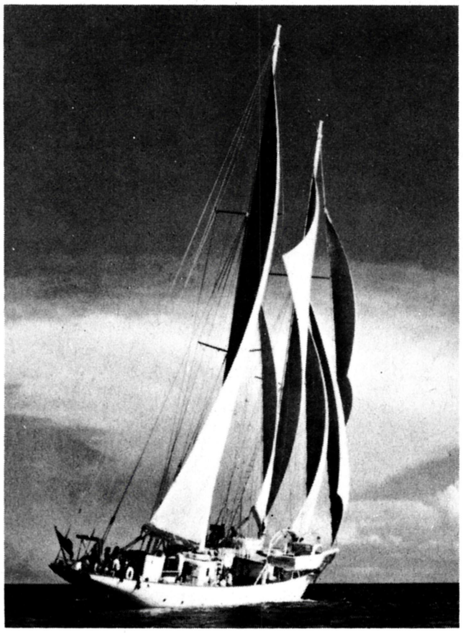

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SMAL/80 is a new structured assembly language with macro capabilities for the 8080 processor (and also the 8085 and Z-80). SMAL/80 could be called a "high-level assembler" and uses an indented, symbolic notation and structured constructs such as DO-END, IF-THEN-ELSE, and LOOP-REPEAT. These may be combined or nested to any depth. The compiler and macro processor both reside in 7K of memory. The intention in writing this language was to provide a means to write complex assembly-language programs with the ease of using a high-level structured language (similar to ALGOL or PL/M). SMAL/80 and its predecessor, SMAL, were developed by Dr. Charles Popper at Bell Labs. The language is expected to be released in the first half of 1978 after testing. The expected price for the CP/M version, on diskette, is $75; cassette versions will be offered later.

Below is an example of a bubble-sort program, coded in SMAL/80.

```
               A SMAL/80 BUBBLESORT


SIZE EQU 255;
D = 1;
LOOP;
   D = 0;
   HL = N;
   B = M(HL);
   HL = ARRAY;
   LOOP;
      IF --B ZERO      /* NO MORE PAIRS LEFT */
         BREAK;
      A = M(HL);
      ++HL;
      IF A : M(HL) NEG  THEN
         DO      /* DO AN INTERCHANGE */;
            C = M(HL);
            M(HL) = A;
            --HL;
            M(HL) = C;
            ++HL;
            D = 1;
         END;
   REPEAT;
REPEAT WHILE [A = B; A = A OR A] NOT ZERO;


N:       BYTE        SIZE;
ARRAY:   RESERVE     SIZE;


END PROGRAM;
```

```
DAY'S PAY

     ENTER.
     DISPLAY ID.
     PROCEED.
     PRESS BUTTON.
     RIDE ELEVATOR.
     SIT AT DESK.
     READ.
     WRITE.
     DISPLAY KNOWLEDGE.
     IF NOON,
          EAT LUNCH,
          RETURN TO DESK.
     IF END OF DAY,
          LEAVE OFFICE,
          EAT,
          PLAY,
          REST.
               GOTO DAY'S PAY.

          -- Art Swanson
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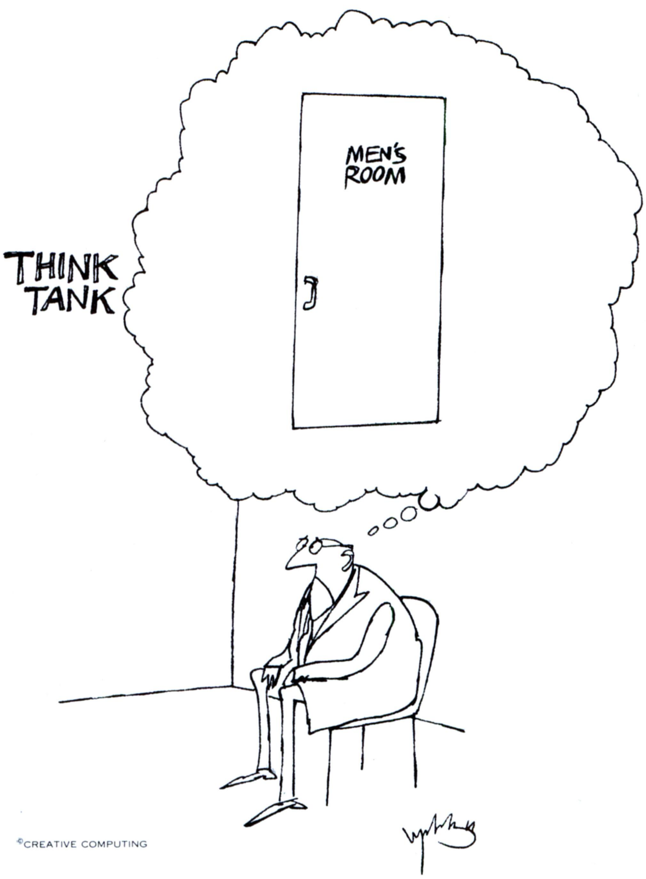

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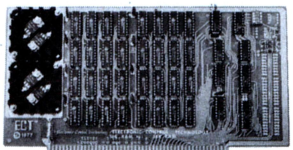

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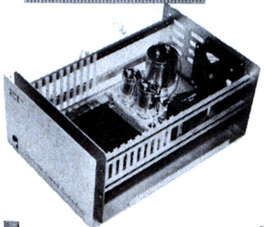

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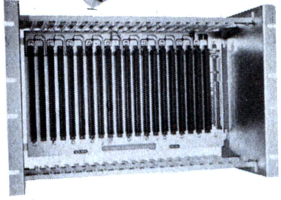

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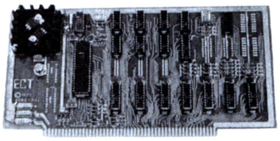

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Evaluating Stock Options or How to Lose it a Little Slower

Allen C. Hagelberg

It seems to me that when investing in the stock-option market, we continually need to know and do the following things:

1. Know our current stock-option positions.
2. Find and evaluate the best stock-option transactions.
3. Determine the "return on investment," "cash flow," and "total impact for each transaction."

Knowledge of the stock-option positions and determining the total impact for each transaction follow standard accounting practices, but finding a good stock-option transaction is a problem. Many stock-option strategies are available, but selling options against stock that we buy is the least risky and the consistently most profitable venture[1]. Evaluating this investment strategy is the subject of this computer program.

In this strategy, 100 shares of stock are bought and used as collateral for each call option sold. This call option is sold at a premium, giving the buyer of the option the right to purchase the stock at a set price (known as the strike point) for a given length of time (the life of the options). A detailed definition of option trading is given in references 1 and 2. The parameters of this strategy are:

1. Price of the stock
2. Strike point
3. Life of the option
4. Value of the premium.

In this computer program, we will input this data and vary the projected value of the stock from 40% to 160% of its current value. This program will then calculate the projected return on investment for the life of the option. By analyses of these data with other stock-option combinations, we can find the best transactions.

For example—from the Los Angeles Times' listing of the Chicago Board Option Exchange (CBOE) transactions of January 20, 1976, we can evaluate the Brunswick options of April 15 at 7/16 and July 15 at 3/4. The previous day closing stock price was 12-3/4. At the start of the program, the following questions are asked:

```
NAME OF THE STOCK=
PRICE OF THE STOCK=
STRIKE POINT=
TODAYS DATE-MO,DAY,YEAR=
JAN,APRIL,JULY,OCT PREMIUM=
```

As the data is input, the printout takes the following form:

```
NAME OF THE STOCK=?BRUNSWICK
PRICE OF THE STOCK=?12.75
STRIKE POINT=?15
TODAYS DATE-MO,DAY,YEAR=?1,20,75
JAN,APRIL,JULY,OCT PREMIUM=?0,0.4375,0.75,0
MONTH OF THE CALL= 4.00
EFFECTIVE WRITING RATIO= 1.00
INITIAL INVESTMENT= 1254.41     TOTAL INVESTMENT= 1284.12
     S.VAL        RET          ROI          ROI/Y
      17.85      215.88       16.81         60.34
      16.58      215.88       16.81         60.34
      15.30      215.88       16.81         60.34
      14.03      118.38        9.22         33.09
      12.75       -9.12       -0.71         -2.55
      11.48     -136.62      -10.64        -38.19
      10.20     -264.12      -20.57        -73.83
       8.93     -391.62      -30.50       -109.46
       7.65     -519.12      -40.43       -145.10
       6.38     -646.62      -50.36       -180.74
       5.10     -774.12      -60.28       -216.38
```

Line by line we have:

Input Line 2. Name of stock = Brunswick
Line 3. Price =$12.75
Line 4. Strike point = 15
Line 5. Date = 1, 20, 76
Line 6. Jan premium 0 (Jan 76, expiration date has passed)
April premium .4375 (0.4375 = 7/16)
July premium .75 (0.75 = 3/4)
Oct premium 0 (Oct 76, Brunswick option, not open)

Output Line 7. Jan is zero, thus disregard. April has a premium and is designated as the 4th month; so month of call = 4.
Line 8. Writing ratio is set to 1 (forget this term for now; more about this later.)
Line 9. Initial investment = $1254.41
Total investment = $1284.12

The remainder of the tabulation shows how the Return, Return on Investment (ROI), and ROI annualized vary as a function of stock price from $5.10 to $17.85 per share. Thus, if the stock remains at $12.75 for the life of the option, we would lose $9.12. However, if the stock moves to more than $15, we make $215.88 or 16.8% ROI or 60% per year, annualized. Likewise, we can evaluate the downside or loss potential.

Let's say we do not like that transaction. Suppose we sell 2 options for every 100 shares of stock to see if we can improve our profit.

Allen C. Hagelberg, 23711 Prospect Valley Dr., Diamond Bar, CA 91765.

In the following printout, the writing ratio in line 2 is 2. This is accomplished through the "For L = 1 to 2," in line 280 of the program. We then have the following:

```
MONTH OF THE CALL= 4.00
EFFECTIVE WRITING RATIO= 2.00
INITIAL INVESTMENT= 1212.15     TOTAL INVESTMENT= 1240.86
     S.VAL         RET          ROI          ROI/Y
      17.85    -1240.86      -100.00      -358.93
      16.58    -1240.86      -100.00      -358.93
      15.30    -1240.86      -100.00      -358.93
      14.03      161.64        13.03        46.76
      12.75       34.14         2.75         9.88
      11.48      -93.36        -7.52       -27.00
      10.20     -220.86       -17.80       -63.89
       8.93     -348.36       -28.07      -100.77
       7.65     -475.86       -38.35      -137.65
       6.38     -603.36       -48.62      -174.53
       5.10     -730.86       -58.90      -211.41
```

Tabulation shows that if the stock remains at $12.75, then we make $34.14 for the life of the option. If it goes to $14.03, we make $161.64 or 14%, which is more than the 9.2% we had with a writing ratio = 1. But if the stock moves above the strike point of $15.00, we may lose. How much we lose depends on where and how we cover the call, but that's another point in time and another transaction. This program is limited up to the strike point, and the $1240 loss is meaningless.

Again, let's say we would like to keep looking for a better opportunity. Because of the way we have inputted the data, this program continues by evaluating the July option at 0.75. This is accomplished through "For K = 1 to 10 step 3" of line 180 of the program. We then have:

```
MONTH OF THE CALL= 7.00
EFFECTIVE WRITING RATIO= 1.00
INITIAL INVESTMENT= 1151.78     TOTAL INVESTMENT= 1203.53
     S.VAL         RET          ROI          ROI/Y
      17.85      296.47        24.63        46.60
      16.58      296.47        24.63        46.60
      15.30      296.47        24.63        46.60
      14.03      198.97        16.53        31.27
      12.75       71.47         5.94        11.23
      11.48      -56.03        -4.66        -8.81
      10.20     -183.53       -15.25       -28.85
       8.93     -311.03       -25.84       -48.89
       7.65     -438.53       -36.44       -68.92
       6.38     -566.03       -47.03       -88.96
       5.10     -693.53       -57.62      -109.00
```

Analyzing this stock-option transaction, we have a 5.9% ROI for a six-month period. Also, we have a maximum return of $296.47 at 24.6% ROI and some downside protection if the stock price falls. This kind of analysis can continue with myriad possible combinations.

```
MONTH OF THE CALL= 7.00
EFFECTIVE WRITING RATIO= 2.00
INITIAL INVESTMENT= 1006.88     TOTAL INVESTMENT= 1052.12
     S.VAL         RET          ROI          ROI/Y
      17.85    -1052.12      -100.00      -189.16
      16.58    -1052.12      -100.00      -189.16
      15.30    -1052.12      -100.00      -189.16
      14.03      350.38        33.30        63.00
      12.75      222.88        21.18        40.07
      11.48       95.38         9.07        17.15
      10.20      -32.12        -3.05        -5.77
       8.93     -159.62       -15.17       -28.70
       7.65     -287.12       -27.29       -51.62
       6.38     -414.62       -39.41       -74.54
       5.10     -542.12       -51.53       -97.47
LONG TERM
```

The program is written in BASIC on an HP 9830 and has a file size of 557 words. As with most programs, certain simplifying assumptions lead to limitations and a margin of error. In the program listing, line 200 assumes 30.4225 days per month. The April option will expire on the 17th, but the program used 4x30.4225 less the number of days we were into the year 1976, thus a 13-day error. Line 310 uses 1.7% as stock commission and 3.4% option commission, whereas commissions are not the same throughout the industry. Also, we have not accounted for the closing transaction costs.

Line 330 uses 8.5% interest on the margin account, but interest rates will change from time to time. Line 430 uses (S1+0.25) as the point where the option is exercised. However, this could be as low as 0.0625 above the strike point. Finally, if we work down the listing to line 580 and D5 >180, then we can possibly use this transaction in "long-term" tax benefits, depending on how and when we close out the transaction (ref. 6).

Of course, several other program expansions can be added and other possible costs and benefits analyses are possible, but this run gives us a good indication of which stock-option combinations are better than others.

```
10 DIM G$[20]
20 DIM E[10]
30 FIXED 2
40 P3=P4=P5=0
50 B1=A=D1=D2=D3=D4=D5=L=0
60 N=M=Y=C1=I1=I2=R8=R9=Z1=Z2=S2=0
70 N1=N2=100
80 PRINT "NAME OF THE STOCK=";
90 INPUT G$
100 PRINT "PRICE OF THE STOCK=";
110 INPUT P1
120 PRINT "STRIKE POINT=";
130 INPUT S1
140 PRINT "TODAYS DATE-MO,DAY,YEAR=";
150 INPUT M,N,Y
160 PRINT "JAN,APRIL,JULY,OCT PREMIUM=";
170 INPUT E[1],E[4],E[7],E[10]
180 FOR K=1 TO 10 STEP 3
190 IF E[K]=0 THEN 570
200 D1=K*30.4225
210 P2=E[K]
220 IF Y=77 THEN 250
230 D4=0
240 GOTO 260
250 D4=365
260 D5=D1+D4-((M-1)*30.4225)-N
270 P3=P1*N1
280 FOR L=1 TO 2
290 N2=N2*L
300 P4=P2*N2
310 C1=(P3*0.017)+(P4*0.034)
320 I1=P3-P4+C1
330 I2=I1*0.085*D5/365
340 I3=I1+I2
350 PRINT "MONTH OF THE CALL=";K
360 PRINT "EFFECTIVE WRITING RATIO=";L
370 PRINT "INITIAL INVESTMENT=";I1;
380 PRINT "TOTAL INVESTMENT="I3;
400 PRINT "       S.VAL        RET          ROI            ROI/Y"
410 FOR A=-4 TO 6
420 P5=P3*(1-(A*0.1))
430 IF (P5/N1)>(S1+0.25) THEN 480
440 R8=P5-I3
450 Z1=0
460 GOTO 500
470 I3=I3+P5*(1-L)
480 R8=S1*N1-I3-S1*(L-1)*100
490 Z1=(((P5/N1+1)-(P2*1.068))*100)/(P2*1.068)
500 R9=R8/I3*100
510 S2=P5/N1
520 M1=R9/(D5/365)
530 FORMAT 6F11.2
540 WRITE (15,530)S2,R8,R9,M1
550 NEXT A
560 NEXT L
570 NEXT K
580 IF D5>180 THEN 600
590 GOTO 610
600 PRINT "LONG TERM"
610 END
```

References

1. Gary L. Gastineau, "The Stock Option Manual," McGraw-Hill Book Company, pp. 39-91, 1975.
2. The Option Clearing Corporation, Prospectus, January 6, 1975. ■

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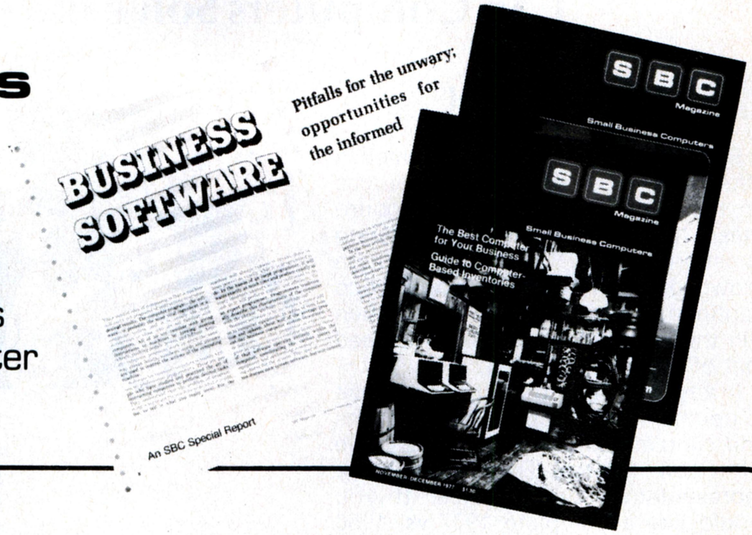
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CIRCLE 163 ON READER SERVICE CARD

Can Computers Solve the Population Problem?

David H. Ahl

Population growth has an immense effect on the use of various resources on the earth and in individual countries. It also leads to interesting questions like, "If the population growth of the United States and Mexico continue at their present rates, when will the population of Mexico exceed that of the United States?"

In any event, it's probably worthwhile to update the old population problems and simulations every once in a while with new figures. Below are some representative 1977 figures. If you would like a complete 1977 vs. 1950 population chart showing every country of the world, write to The Environmental Fund, 1302 Eighteenth St., NW, Washington, DC 20036. They're a non-profit agency, so you might include $1 or $2 to help defray the cost — the chart is well worth it. (We've found the population estimates of The Environmental Fund to be better documented and, therefore, probably more accurate, than those of both the United Nations and the U.S. Census Bureau.)

POPULATION DOUBLING TIME

Population Growth Rate %	Number of Years to double Population
0.5	139
1.0	69
1.5	46
2.0	35
2.5	28
3.0	23
3.5	20
4.0	17

Major Area	*Population Estimates (Millions) Mid 1977*	*Growth Rate (%)*	*Birth Rate (Per 1000 Population)*	*Death Rate (Per 1000 Population)*	*1950 Population (Millions)*
World	4307.4	2.1	34	13	2542.8
Africa	451.2	2.8	46	20	218.9
Asia	2505.7	2.4	38	14	1408.5
North America	249.0*	1.5	14	9	166.1
Latin America	341.8	2.8	37	9	164.4
Europe	478.8	0.6	15	11	392.4
USSR	259.4	1.0	18	9	180.1
Oceania	21.8	1.8	22	9	12.4
Selected Countries					
Libya	2.6	4.1	45	15	.95
Nigeria	89.3	2.9	49	23	34.3
Iraq	11.8	3.4	48	15	5.2
Kuwait	1.1	6.1	47	5	.1
Japan	113.5	1.1	17	6	83.8
China, People's Rep.	987.3	2.4	36	12	556.3
United States	225.6*	1.5	14	9	152.3
Mexico	62.6	3.5	44	7	26.5
Brazil	116.1	2.9	37	9	53.3
Sweden	8.3	0.4	12	11	7.0
Germany, Fed. Rep.	62.2	0.1	10	12	50.0
German, Dem. Rep.	16.8	-0.2	11	14	18.4

*U.S. population figures include an estimate of 1.7 million from illegal immigration, derived from U.S. Immigration and Naturalization Service reports. Corresponding adjustments have *not* been made to other figures, most notably Mexico.

* * *

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CIRCLE 150 ON READER SERVICE CARD

Solution to Cryptic Message from page 168.

I received a very severe message today from Colonel Stager. I think it unjust. Please see my reply to him. Thanking you and the Colonel for past confidence and kindness. I beg leave to tender my resignation.

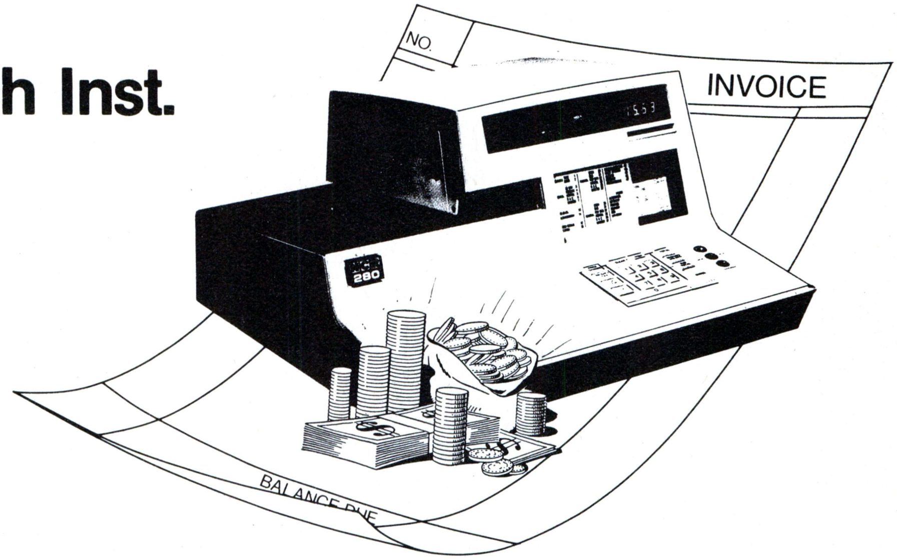
— McCaine

BREMEN is simply a keyword that indicated that the message was written from left to right in six columns. The seventh row was filled out with four null words and a blank space. Encipherment was accomplished by going up and down the columns in a prearranged sequence and adding additional null words.

Evidently, Operator McCaine was prevailed upon to reconsider his resignation. He ended his career in 1865 on the staff of General Sheridan. He was credited with sending an intercepted confederate message, which caused General Robert E. Lee's last food train to be captured, leading shortly to the Appomatox surrender.

ACCOUNTS RECEIVABLE:

Scientific Research Inst.



Scientific Research Inst. has three accounts receivable programs. The first is in Volume III of their BASIC Software Library, "Advanced Business" ($39.95) by R. W. Brown, as part of a Billing and A/R program that can be input from audio cassette. There are no external files, because all the data is contained in DATA statements.

The second accounts receivable program is in the front of Volume VI, "A Complete Business System" ($49.95, same author), as a module of a large system, which is a disk interactive version of (although not identical in all parts to) the Volume III program. The user can make up a business system from both Volumes III and VI, using disk interactive programs where desired.

The third program is described extensively in the back of Volume VI; and as the forward puts it, "the entire source code for this complete business system program is not included due to its proprietary matter." This proprietary package is available from Scientific Research Inst., 220 Knollwood, Key Biscayne, FL 33149.

First A/R Program

The first accounts receivable program, which takes up a little over eight pages and about 400 lines of BASIC statements, is described this way in Volume III:

Description

This is a Billing and Accounts Receivable program. It does not use any external data files. All of the data is self-contained within the program. It generates the following five kinds of reports: Mailing labels, Customer bills, A/R, Sales and a last purchase report.

Users

This program would be used by individuals or companies engaged in selling merchandise or services.

Instructions

All of the customer and billing data must be updated in data statements before the program is run. Initially the data must be input to the program, then, after the first execution, the program with the data included is saved on paper or magnetic tape. After this the data only needs to be updated as it changes. List the program for detailed information about data entry and updating.

Limitations

As this program does not use files it should execute in any BASIC-speaking computer that has sufficient on-line storage. The program is set up with sample data that must be removed before entering your data. It is set for a maximum of 100 customers. This number is set in the DIM statements on lines 1100 and 1120. The source code requires 12K bytes of memory for program storage. The amount of memory required for execution is a function of the number of customers you have. This is set in the DIM statements. With it set for 100 customers, the program will require about 31K bytes for execution. Included after the source-code listing is an executed run using the data presently contained in the program.

Second A/R Program

This is a disk interactive version of the Billing and Accounts Receivable program that appears in Volume III of this set. This version generates the same reports as the program in Volume III except it also allows the data base to be updated interactively.

The source code for this program is 8K bytes long and the program will execute in 12K of available memory. While most of the BASIC statements

```
WHICH REPORT WOULD YOU LIKE TO RUN: ?3


   C U S T O M E R S     A / R     R E P O R T     3/8/76


ACC#            A/R $            PAYMENTS         LS DATE        CUST NAME

        37116           574.51            711.26   12/17/75   WESTAIM SALES CO.
        45686             3.94             21.76   2/17/76   REMINGTON CAN
        78192            95.81            213.5    2/1/76   DIGITRAN CO.
        93216            16.14            113.35   2/6/76   SUPERIOR ELEC.



TOTAL PAYMENTS        = $ 1059.87
TOTAL ACCOUNTS/REC. = $   690.4


THE FOLLOWING IS A LIST OF REPORTS THAT THIS PROGRAM
WILL GENERATE. TO CHOOSE ONE TYPE IT'S NUMBER WHEN ASKED.

       1 - PRINT MAILING LABELS
       2 - PRINT UP BILLS
       3 - CUSTOMER A/R REPORT
       4 - SALES REPORT
       5 - LAST PURCHASE REPORT
       6 - STOP PROGRAM
```

In the first SRI Billing and Accounts Receivable program, the user has selected item 3 from the menu, the Customer A/R Report.

```
THIS SUBSECTION ALLOWS YOU TO SORT YOUR A/R RECORDS IN A VARIETY OF
SEQUENCES AND THEN PRINT A REPORT.

THE SEQUENCES ARE:
                    1 - CUSTOMER #
                    2 - CUSTOMER NAME
                    3 - CITY
                    4 - STATE
                    5 - ZIP CODE
                    6 - # OF TRANSACTIONS
                    7 - EXIT WITHOUT SORTING.
WHICH SEQUENCE? 2
CUSTOMER    CUSTOMER                 STREET                                               ZIP                    #
  NO.         NAME                   ADDRESS              CITY          STATE             CODE           TRANSACTIONS
-------------------------------------------------------------------------------------------

10          CASH SALE ACCOUNT        0                    0             0                 0                      9
78192AC     DIGITRAN                 3421 LAWRENCE ST.    PASADENA      CA.               91105                  3
51376H      OMEGA                    P.O. BOX 4045        STANFORD      N.J.              91268                  0
45686       REMINGTON CAN CO.        2314 SHERWOOD AVE.   LAKESIDE      TX.               45217                  2
93216DA     SUPERIOR ELECTRIC        BOX 30               READER        PA.               16804                  4
37116DH     WESTHAM SALES CO.        327 N. CHERRY ST.    MELROSE       IL.               37215                  4
```

In the second SRI Billing and Accounts Receivable program, the user has selected item 2, which sorts the A/R records in the customer-name sequence.

```
THIS SUBSECTION ALLOWS YOU TO SORT YOUR A/R RECORDS IN A VARIETY OF
SEQUENCES AND THEN PRINT A REPORT.

THE SEQUENCES ARE:
                    1 - CUSTOMER #
                    2 - CUSTOMER NAME
                    3 - CITY
                    4 - STATE
                    5 - ZIP CODE
                    6 - # OF TRANSACTIONS
                    7 - EXIT WITHOUT SORTING.
WHICH SEQUENCE? 7

THIS IS THE ACCOUNTS RECEIVABLE SECTION.
IT WILL HANDLE ALL TRANSACTIONS INVOLVING SALES.

IT OFFERS EIGHT MODES OF OPERATION:
                    1 - A/R LEDGER
                    2 - PRINT MAILING LABLES
                    3 - PAST DUE ACCOUNTS LIST
                    4 - PRINT CUSTOMERS BILLS
                    5 - SALES REPORT
                    6 - SORT ACCOUNTS
                    7 - UPDATE CUSTOMER ACCOUNTS
                    8 - FINISNED WITH A/R SECTION
WHICH WOULD YOU LIKE TO DO? 7


FOR EACH ACCOUNT CHANGE, ENTER A NUMBER DEFINING THE CHANGE.
                    0 - END
                    1 - OLD CUSTOMER UPDATE
                    2 - ADD NEW CUSTOMER
WHICH ONE? 2

ENTER NEW CU. #, NAME, ST., CITY, ST., ZIP, # OF TRANSACTIONS.
? AA72316,WILSON SUPPLY,315 WESTWOOD,RICHMOND,VA.,22086,1
INPUT - ITEM #, QUANTITY, UNIT PRICE, MONTH, DAY, PAYMENT, DESC.
? 876512,2,6.36,6,25,10,WIRE MESH

FOR EACH ACCOUNT CHANGE, ENTER A NUMBER DEFINING THE CHANGE.
                    0 - END
                    1 - OLD CUSTOMER UPDATE
                    2 - ADD NEW CUSTOMER
WHICH ONE? 0

IF YOU HAVE EXCESSIVE TRANSACTIONS FOR ANY OF YOUR
CUSTOMERS YOU WOULD LIKE TO REMOVE, TYPE A '1' OTHERWISE
TYPE A '0'? 0

THIS IS THE ACCOUNTS RECEIVABLE SECTION.
IT WILL HANDLE ALL TRANSACTIONS INVOLVING SALES.

IT OFFERS EIGHT MODES OF OPERATION:
                    1 - A/R LEDGER
                    2 - PRINT MAILING LABLES
                    3 - PAST DUE ACCOUNTS LIST
                    4 - PRINT CUSTOMERS BILLS
                    5 - SALES REPORT
                    6 - SORT ACCOUNTS
                    7 - UPDATE CUSTOMER ACCOUNTS
                    8 - FINISNED WITH A/R SECTION
WHICH WOULD YOU LIKE TO DO? 7
```

The second program displays various menus that allow the user to choose sequence, mode of operation, type of change, etc.

are fairly straightforward, the disk I/O calls may not be compatible with your system. In this event you will be required to modify these five programs to meet the requirements of the BASIC that you are using.

Third A/R Program

Much of the explanatory text accompanying the programs in the latter two-thirds of Volume VI, called "A Complete Business System, ACBS rev:80," was reprinted in the SRI Inventory Control article in the March-April issue of *Creative Computing* (pages 116-120).

Accounts Receivable

The A/R (Accounts Receivable) section allows the printing of all accounts that are older than 30 days. If account aging is desired it will have to be done through a dummy account set up in the A/P (Accounts Payable) file. For example: an A/P account #30, aging 30 days can be set up, likewise one for 45, 60 and/or 90 days may also be set up. Enter the amount of aging desired as a purchase or bill but Don't enter any payment. To zero an account enter a negative purchase equal to the amount still owing.

Inventory

The saleable or merchandise inventory contains quantity on hand and unit cost. The unit cost of each item may be changed each time its quantity is increased or the inventory is updated. Each time an inventory item is purchased the inventory must be updated. In addition to updating the inventory section the accounts payable section will also have to be updated. If the transaction involves cash being paid out at the same time the inventory item is purchased then update or create: A/P account #010. The updating consists of entering the amount of the purchase and also entering this same amount as a payment. This allows the #010 account to zero itself and also subtracts the payment from the Cash on Hand account, contained in the Miscellaneous file.

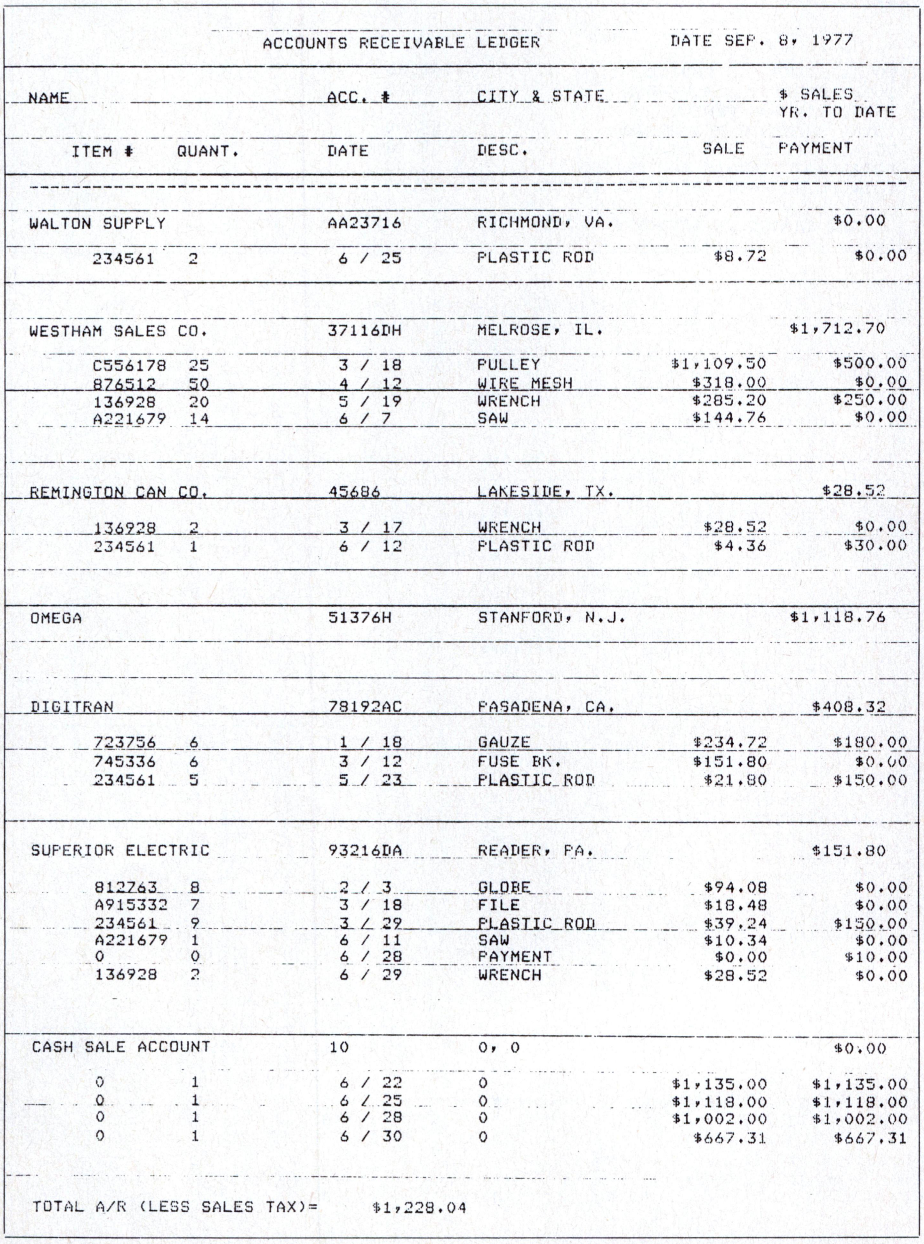
All entries in Inventory, A/P and A/R will have to be entered twice, as the program is based on a double entry system and these three sections are interactive. Every time a bill comes in it can be added to its respective account, unless it is one of the twelve itemized expense items. These items are updated in the expense section when the bill is paid. All other bills are added to the A/P section when they are received. If it is necessary to add to your Cash on Hand as a separate item then update the A/P account #010 and enter a negative amount equal to the amount of cash to be added as a purchase and then enter this same negative amount as a payment, this zeros the #010 account and adds the amount to Cash on Hand.

The A/R (Accounts Receivable) section will update cash on hand but not the inventory section. Therefore for each transaction it will be necessary to first update the A/R section and then update the inventory section by subtracting the quantities for each item sold. To add cash sales to cash on hand, enter a transaction to the A/R #010 account as a receivable and then enter it again as a payment with both amounts being equal. This allows the cash sales account to zero itself while at the same time updating cash on hand and generating a cash sales log for future records. If this log becomes too long it may be reduced by an appropriate entry at the end of the A/R updating section. Whenever a customer makes a payment on his account it is automatically added to cash on hand as soon as it is entered as a payment. ■

FILE STRUCTURES

File #3—A/R

N# (number of customers), Customer #, Customer Name, Street address, City, State, Zip, Total $ sales yr. to date, Total sales since last P & L, # of outstanding transactions, !Item #, Quantity purchased, Unit Selling price, month (1-12) of purchase, day of purchase, Payments made in $'s, Description1



```
                         ACCOUNTS RECEIVABLE LEDGER              DATE SEP. 8, 1977

NAME                          ACC. #          CITY & STATE                $ SALES
                                                                          YR. TO DATE

      ITEM #    QUANT.        DATE            DESC.                 SALE    PAYMENT
-------------------------------------------------------------------------------------

WALTON SUPPLY                 AA23716         RICHMOND, VA.                    $0.00

      234561     2             6 / 25         PLASTIC ROD           $8.72      $0.00


WESTHAM SALES CO.             37116DH         MELROSE, IL.                 $1,712.70

      C556178   25             3 / 18         PULLEY            $1,109.50    $500.00
      876512    50             4 / 12         WIRE MESH           $318.00      $0.00
      136928    20             5 / 19         WRENCH              $285.20    $250.00
      A221679   14             6 / 7          SAW                 $144.76      $0.00


REMINGTON CAN CO.             45686           LAKESIDE, TX.                   $28.52

      136928     2             3 / 17         WRENCH               $28.52      $0.00
      234561     1             6 / 12         PLASTIC ROD           $4.36     $30.00


OMEGA                         51376H          STANFORD, N.J.               $1,118.76


DIGITRAN                      78192AC         PASADENA, CA.                  $408.32

      723756     6             1 / 18         GAUZE               $234.72    $180.00
      745336     6             3 / 12         FUSE BK.            $151.80      $0.00
      234561     5             5 / 23         PLASTIC ROD          $21.80    $150.00


SUPERIOR ELECTRIC             93216DA         READER, PA.                    $151.80

      812763     8             2 / 3          GLOBE                $94.08      $0.00
      A915332    7             3 / 18         FILE                 $18.48      $0.00
      234561     9             3 / 29         PLASTIC ROD          $39.24    $150.00
      A221679    1             6 / 11         SAW                  $10.34      $0.00
      0          0             6 / 28         PAYMENT               $0.00     $10.00
      136928     2             6 / 29         WRENCH               $28.52      $0.00


CASH SALE ACCOUNT             10              0, 0                             $0.00

      0          1             6 / 22         0                 $1,135.00  $1,135.00
      0          1             6 / 25         0                 $1,118.00  $1,118.00
      0          1             6 / 28         0                 $1,002.00  $1,002.00
      0          1             6 / 30         0                   $667.31    $667.31


TOTAL A/R (LESS SALES TAX)=      $1,228.04
```

An Accounts Receivable Ledger, previously updated with the use of the menus shown in the previous figure.

Video Terminals
$649.50 $15 packing
Datapoint 3000, 3360 CRT's
Std. ASCII, RS-232, many features
Fully Assembled, Guaranteed
REFURBISHED
TELECOM. Box 4117 (703) 683-4019
Alexandria, Virginia 22303

CIRCLE 145 ON READER SERVICE CARD

Baltimore
&
Washington
COMPUTERS
ETC...

For Friendly
Help and
Advice

13A Allegheny Ave., Towson, Md.
(301) 296-0520

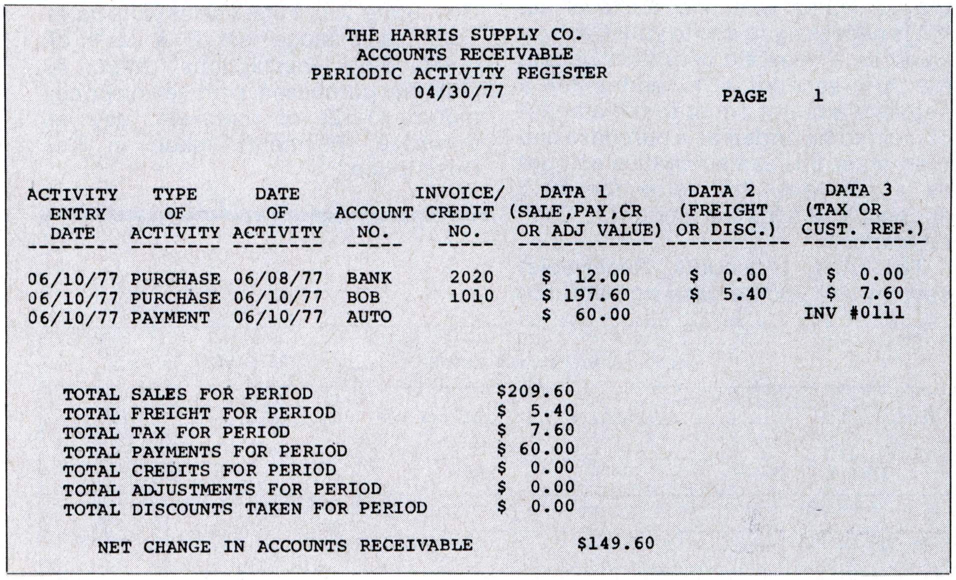
9330 Georgia Ave., Silver Spring, Md.
(301) 588-3748

OPEN 7 DAYS A WEEK

CIRCLE 154 ON READER SERVICE CARD

ACCOUNTS RECEIVABLE:

Altair Software Distribution Co.



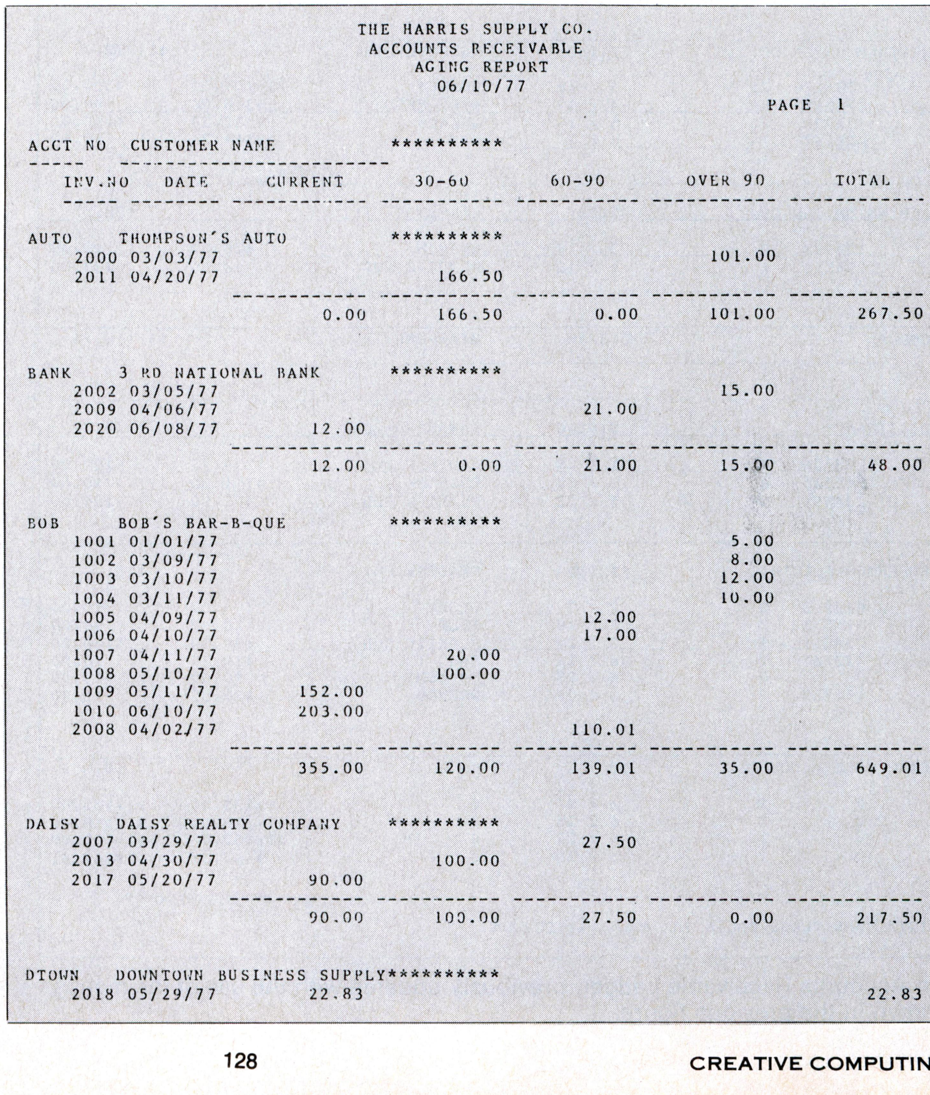
```
                           THE HARRIS SUPPLY CO.
                            ACCOUNTS RECEIVABLE
                        PERIODIC ACTIVITY REGISTER
                                 04/30/77                        PAGE    1


ACTIVITY   TYPE      DATE               INVOICE/   DATA 1          DATA 2        DATA 3
 ENTRY      OF        OF      ACCOUNT  CREDIT  (SALE,PAY,CR      (FREIGHT      (TAX OR
 DATE    ACTIVITY  ACTIVITY     NO.      NO.    OR ADJ VALUE)   OR DISC.)    CUST. REF.)
-------- -------- --------   -----    -----    -------------  ------------  -----------

06/10/77 PURCHASE 06/08/77   BANK      2020     $  12.00       $  0.00       $  0.00
06/10/77 PURCHASE 06/10/77   BOB       1010     $ 197.60       $  5.40       $  7.60
06/10/77 PAYMENT  06/10/77   AUTO               $  60.00                    INV #0111


   TOTAL SALES FOR PERIOD                  $209.60
   TOTAL FREIGHT FOR PERIOD                $  5.40
   TOTAL TAX FOR PERIOD                    $  7.60
   TOTAL PAYMENTS FOR PERIOD               $ 60.00
   TOTAL CREDITS FOR PERIOD                $  0.00
   TOTAL ADJUSTMENTS FOR PERIOD            $  0.00
   TOTAL DISCOUNTS TAKEN FOR PERIOD        $  0.00

      NET CHANGE IN ACCOUNTS RECEIVABLE           $149.60
```



```
                            THE HARRIS SUPPLY CO.
                             ACCOUNTS RECEIVABLE
                                AGING REPORT
                                  06/10/77

                                                                   PAGE  1

ACCT NO  CUSTOMER NAME                **********
-----  -------------------------
   INV.NO   DATE      CURRENT      30-60       60-90       OVER 90      TOTAL
   ----- -------- ----------- ----------- ----------- ----------- -----------

AUTO     THOMPSON'S AUTO              **********
    2000 03/03/77                                              101.00
    2011 04/20/77                  166.50
                  ----------- ----------- ----------- ----------- -----------
                         0.00      166.50        0.00      101.00      267.50


BANK     3 RD NATIONAL BANK           **********
    2002 03/05/77                                               15.00
    2009 04/06/77                                  21.00
    2020 06/08/77       12.00
                  ----------- ----------- ----------- ----------- -----------
                        12.00        0.00       21.00       15.00       48.00


BOB      BOB'S BAR-B-QUE              **********
    1001 01/01/77                                                5.00
    1002 03/09/77                                                8.00
    1003 03/10/77                                               12.00
    1004 03/11/77                                               10.00
    1005 04/09/77                                  12.00
    1006 04/10/77                                  17.00
    1007 04/11/77                   20.00
    1008 05/10/77                  100.00
    1009 05/11/77      152.00
    1010 06/10/77      203.00
    2008 04/02/77                                 110.01
                  ----------- ----------- ----------- ----------- -----------
                       355.00      120.00      139.01       35.00      649.01


DAISY    DAISY REALTY COMPANY         **********
    2007 03/29/77                                  27.50
    2013 04/30/77                  100.00
    2017 05/20/77       90.00
                  ----------- ----------- ----------- ----------- -----------
                        90.00      100.00       27.50        0.00      217.50


DTOWN    DOWNTOWN BUSINESS SUPPLY**********
    2018 05/29/77       22.83                                           22.83
```

The Accounts Receivable Package contains two main types of data files, the Customer Accounts Master Files and the Transaction Activity Files:

- The Customer Account Files are broken into three sub-files. The primary Customer File contains: account number (5 Alphanumeric Characters); customer name, address and phone number; credit limits and terms; tax and discount rates; dates and amounts of last credit and debit; year-to-date totals; and current and high balance. The second Customer Account subfile maintains a record of all open invoices for a company. The last Customer Account subfile contains a two-month "moving window" of all activity within that account.
- The Transaction Activity files are also separated into three separate files: A Periodic Activity file, which contains the most recent transactions within the system, an Invoice Activity file which contains invoices for the month, and finally a Payment Activity file.

Complete Customer File Maintenance is available for those portions of the file which may be modified. This includes add, change, delete, query and list capabilities. Optional Control Reports may be generated in order to provide hardcopy.

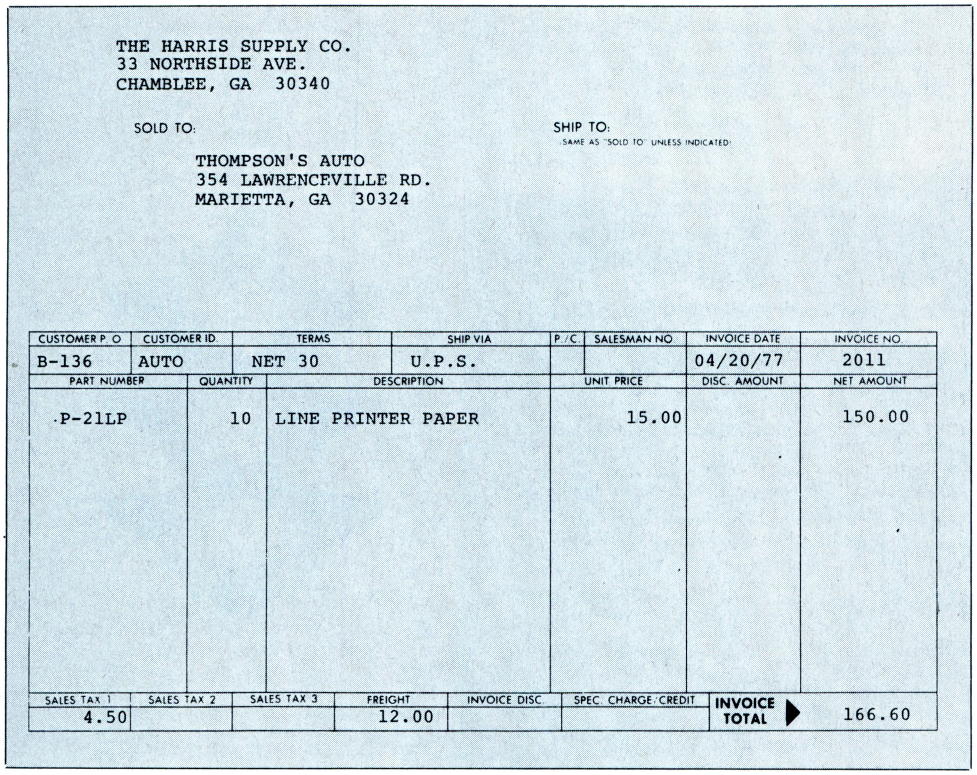
Entry of invoices and payments is provided in a Speed Entry form to maximize operator effectiveness. Entry of Credit Memos and Adjustments is provided for. However, invoices may be entered in a "non-speed" mode and then printed.

The following reports are created by the system:

- Periodic Activity Report
- Aged Accounts Receivable
- Invoice Register
- Payment, Credit and Adjustment Register
- List Current Customer Accounts
- Invoices and Statements

For a typical dual-disk system the Customer Accounts file may contain up to 400 or more companies, each averaging 9 open invoices, and 13 current transactions. This would allow for several hundred transactions to be handled.

The Receivables Package prepares a direct monthly report to the General Ledger, provided that the user has more than one floppy disk unit for data transfer. ■



THE HARRIS SUPPLY CO.
33 NORTHSIDE AVE.
CHAMBLEE, GA 30340

SOLD TO:

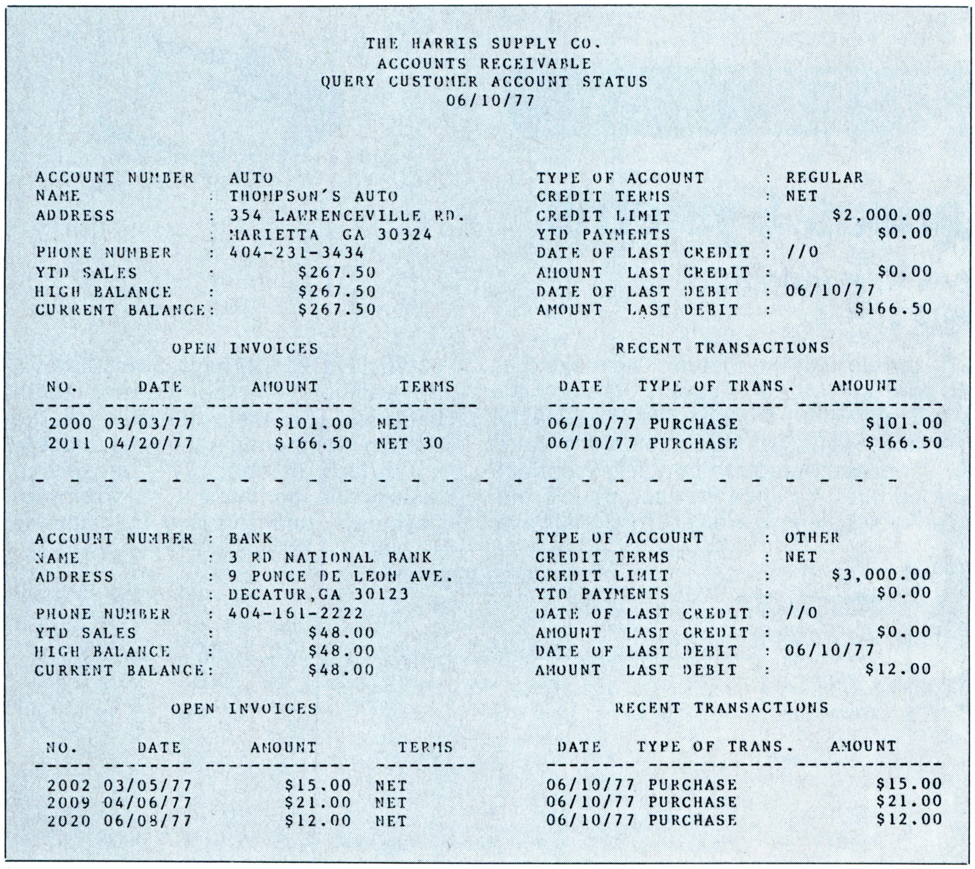
THOMPSON'S AUTO
354 LAWRENCEVILLE RD.
MARIETTA, GA 30324

SHIP TO:
(SAME AS "SOLD TO" UNLESS INDICATED)

CUSTOMER P. O.	CUSTOMER ID	TERMS	SHIP VIA	P/C	SALESMAN NO.	INVOICE DATE	INVOICE NO.
B-136	AUTO	NET 30	U.P.S.			04/20/77	2011

PART NUMBER	QUANTITY	DESCRIPTION	UNIT PRICE	DISC. AMOUNT	NET AMOUNT
P-21LP	10	LINE PRINTER PAPER	15.00		150.00

SALES TAX 1	SALES TAX 2	SALES TAX 3	FREIGHT	INVOICE DISC.	SPEC. CHARGE/CREDIT	INVOICE TOTAL ▶
4.50			12.00			166.60



```
                         THE HARRIS SUPPLY CO.
                          ACCOUNTS RECEIVABLE
                     QUERY CUSTOMER ACCOUNT STATUS
                               06/10/77


ACCOUNT NUMBER   AUTO                     TYPE OF ACCOUNT      : REGULAR
NAME           : THOMPSON'S AUTO          CREDIT TERMS         : NET
ADDRESS        : 354 LAWRENCEVILLE RD.    CREDIT LIMIT         :      $2,000.00
               : MARIETTA   GA 30324      YTD PAYMENTS         :          $0.00
PHONE NUMBER   : 404-231-3434             DATE OF LAST CREDIT  : //0
YTD SALES      :         $267.50          AMOUNT  LAST CREDIT  :          $0.00
HIGH BALANCE   :         $267.50          DATE OF LAST DEBIT   : 06/10/77
CURRENT BALANCE:         $267.50          AMOUNT  LAST DEBIT   :        $166.50

          OPEN INVOICES                            RECENT TRANSACTIONS

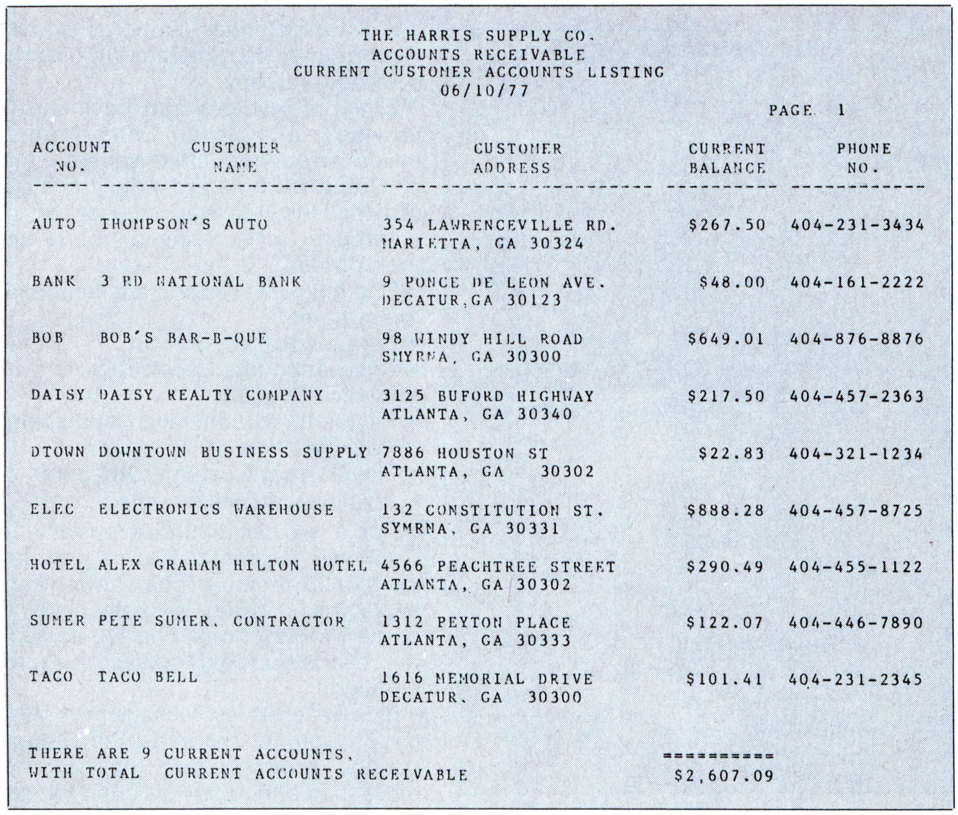
 NO.     DATE        AMOUNT        TERMS         DATE     TYPE OF TRANS.    AMOUNT
----- -------- ------------- ---------        -------- -------------- ------------
 2000 03/03/77       $101.00  NET             06/10/77 PURCHASE            $101.00
 2011 04/20/77       $166.50  NET 30          06/10/77 PURCHASE            $166.50

 -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -  -

ACCOUNT NUMBER : BANK                     TYPE OF ACCOUNT      : OTHER
NAME           : 3 RD NATIONAL BANK       CREDIT TERMS         : NET
ADDRESS        : 9 PONCE DE LEON AVE.     CREDIT LIMIT         :      $3,000.00
               : DECATUR,GA 30123         YTD PAYMENTS         :          $0.00
PHONE NUMBER   : 404-161-2222             DATE OF LAST CREDIT  : //0
YTD SALES      :          $48.00          AMOUNT  LAST CREDIT  :          $0.00
HIGH BALANCE   :          $48.00          DATE OF LAST DEBIT   : 06/10/77
CURRENT BALANCE:          $48.00          AMOUNT  LAST DEBIT   :         $12.00

          OPEN INVOICES                            RECENT TRANSACTIONS

 NO.     DATE        AMOUNT        TERMS         DATE     TYPE OF TRANS.    AMOUNT
----- -------- ------------- ---------        -------- -------------- ------------
 2002 03/05/77        $15.00  NET             06/10/77 PURCHASE             $15.00
 2009 04/06/77        $21.00  NET             06/10/77 PURCHASE             $21.00
 2020 06/08/77        $12.00  NET             06/10/77 PURCHASE             $12.00
```



```
                          THE HARRIS SUPPLY CO.
                           ACCOUNTS RECEIVABLE
                     CURRENT CUSTOMER ACCOUNTS LISTING
                                 06/10/77
                                                               PAGE  1

ACCOUNT        CUSTOMER                  CUSTOMER            CURRENT      PHONE
  NO.            NAME                    ADDRESS             BALANCE       NO.
----- ------------------------ ------------------------- ---------- ------------

AUTO  THOMPSON'S AUTO          354 LAWRENCEVILLE RD.        $267.50 404-231-3434
                               MARIETTA, GA 30324

BANK  3 RD NATIONAL BANK       9 PONCE DE LEON AVE.          $48.00 404-161-2222
                               DECATUR,GA 30123

BOB   BOB'S BAR-B-QUE          98 WINDY HILL ROAD           $649.01 404-876-8876
                               SMYRNA, GA 30300

DAISY DAISY REALTY COMPANY     3125 BUFORD HIGHWAY          $217.50 404-457-2363
                               ATLANTA, GA 30340

DTOWN DOWNTOWN BUSINESS SUPPLY 7886 HOUSTON ST               $22.83 404-321-1234
                               ATLANTA, GA    30302

ELEC  ELECTRONICS WAREHOUSE    132 CONSTITUTION ST.         $888.28 404-457-8725
                               SYMRNA, GA 30331

HOTEL ALEX GRAHAM HILTON HOTEL 4566 PEACHTREE STREET        $290.49 404-455-1122
                               ATLANTA, GA 30302

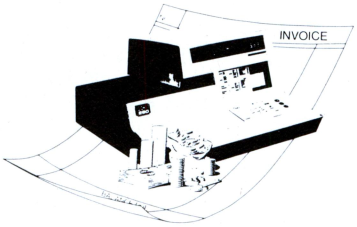
SUMER PETE SUMER, CONTRACTOR   1312 PEYTON PLACE            $122.07 404-446-7890
                               ATLANTA, GA 30333

TACO  TACO BELL                1616 MEMORIAL DRIVE          $101.41 404-231-2345
                               DECATUR, GA  30300

THERE ARE 9 CURRENT ACCOUNTS,                            ==========
WITH TOTAL  CURRENT ACCOUNTS RECEIVABLE                   $2,607.09
```

business computing

ACCOUNTS RECEIVABLE:



Arkansas Systems

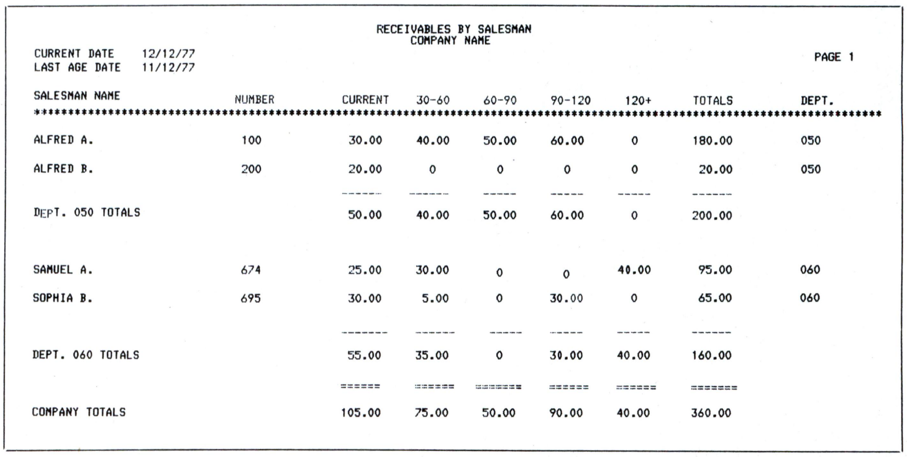
Dr. James K. Hendren
B. Eugene Jones

The *Accounts Receivable System* is the fourth in a series of micro software systems being developed by Arkansas Systems, Inc. *General Ledger* with Financial Reporting and *Payroll* are currently being used by many companies and several OEMs. *Accounts Payable*, and *Accounts Receivable* are under development. *Order Entry, Inventory Control,* and *Time and Material Billing* are planned.

As with the Payroll and General Ledger, Arkansas Systems, Inc. has tried to make Accounts Receivable as flexible as possible for floppy disks; they have also tried to make the system as fool-proof as possible, via on-line editing of input data, automatic backup of files, coordinated-organized system flow, and excellent documentation.

Software Overview

The A/R system has two major and three minor files that contain all information which is used and reported throughout the system. The major files are the Master Account File and the Transaction History File. The master account file has each customer's name, address, person to contact, telephone number, balance for each period, etc. Aged balances are kept for 31-60 days, 61-90 days, 91-120 days, over 120 days, in addition to the current-month balance. The main function of the system is to maintain these balances in an orderly manner. The transaction history file contains a record of all payments, charges, and adjustments



```
                                        RECEIVABLES BY SALESMAN
                                             COMPANY NAME
CURRENT DATE    12/12/77                                                                     PAGE 1
LAST AGE DATE   11/12/77

SALESMAN NAME              NUMBER      CURRENT   30-60    60-90    90-120    120+     TOTALS      DEPT.
*****************************************************************************************************

ALFRED A.                   100         30.00    40.00    50.00    60.00      0       180.00      050

ALFRED B.                   200         20.00      0        0        0        0        20.00      050
                                       ------   ------    -----    -----    -----    ------
DEPT. 050 TOTALS                        50.00    40.00    50.00    60.00      0       200.00


SAMUEL A.                   674         25.00    30.00      0        0      40.00      95.00      060

SOPHIA B.                   695         30.00     5.00      0      30.00      0        65.00      060

                                       -------  ------    -----    -----    -----    ------
DEPT. 060 TOTALS                        55.00    35.00      0      30.00    40.00     160.00
                                       ======   ======   =======   ======   ======   =======
COMPANY TOTALS                         105.00    75.00    50.00    90.00    40.00     360.00
```

made in this invoicing period. This file prints the detailed information appearing in the statement for the current period.

Minor files within the system are the control file, cursor control file, and the salesman file.

The control file contains information about the company—the company name and address, telephone number, number of lines per page on the printer, how many periods within the cyclic billing, what the current process date is, etc. This file generally contains data to which every program needs access. Use of a control file greatly simplifies operation if accounts receivable is being run for more than one company (customers often run several companies). If the company name changes, then instead of changing every program, one short program can be run and the company name will be changed in every program.

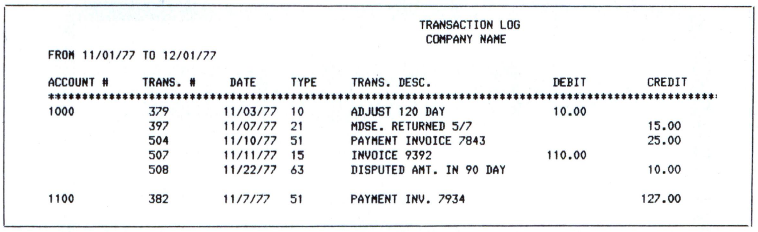
The salesman file keeps receivables by salesman. The cursor control file allows the software to be run on hardware with different types of CRT terminals. A cursor control modification program is included so that the user is not tied to one CRT.

There are various functions that can be selected by the user from a menu. Several of these functions are described below.

Charges, Payments, and Returns Entry

This function allows transactions for any account to be entered, edited, posted, and logged to the history file. Easy English prompts guide the user through each account requiring modification. Initially the program prompts "Enter Account Number or End to Stop." After entering an account number (verified valid upon entry), the system displays a mini-menu containing several types of entries, such as:

CH	for Charge
PY	for Payment
RC	for Current Period Item Returned
R3	for 30 day old return
R6	for 60 day old return
R9	for 90 day old return
RO	for Older than 120 days
EE	to End Tranactions for this customer



```
                                              TRANSACTION LOG
                                               COMPANY NAME
FROM 11/01/77 TO 12/01/77

ACCOUNT #     TRANS. #    DATE      TYPE     TRANS. DESC.                    DEBIT           CREDIT
************************************************************************************************
1000            379     11/03/77  10       ADJUST 120 DAY                  10.00
                397     11/07/77  21       MDSE. RETURNED 5/7                              15.00
                504     11/10/77  51       PAYMENT INVOICE 7843                            25.00
                507     11/11/77  15       INVOICE 9392                   110.00
                508     11/22/77  63       DISPUTED AMT. IN 90 DAY                         10.00

1100            382     11/7/77   51       PAYMENT INV. 7934                              127.00
```

After entering the transaction code, a comment can be entered which will print on this customer's statement, followed by the amount of the transaction. At this time a reference number is generated by the system which will also be printed on the statement. This reference number is valuable in that it provides an audit trail.

Add Account and Change Account

The add account and change account functions are very similar; therefore, they will be discussed together.

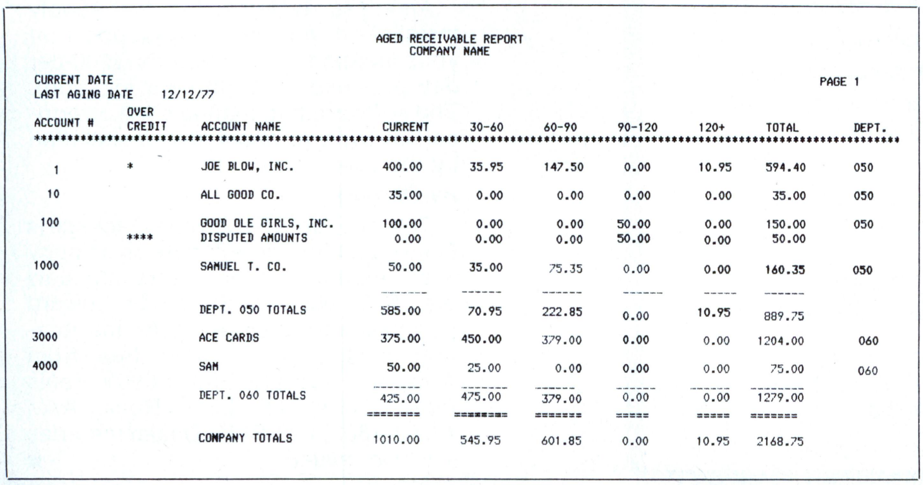
After selecting the function, you will be prompted to enter the account number. The account number will then be verified either as on file (change account) or not on file (add account). If you are in change-account, the current account will be displayed and you will be allowed to change any non-dollar fields. In the add-account function you will be asked to give values for all non-dollar amounts; the dollar amounts will be initialized to zero.

Sort Transactions

This function is automatically called when you choose to write statements, but it can be of value if you wish to print the transactions in the Transaction History Report in account order. If this function is not performed, the report will be in the same order as the transactions were entered.

Age Accounts

This function moves the current balance to the 31-day balance, the 31-day balance to the 61-day balance, etc. This function must be performed only once a month, otherwise it will cause invalid results.



```
                                 AGED RECEIVABLE REPORT
                                      COMPANY NAME

CURRENT DATE                                                                            PAGE 1
LAST AGING DATE    12/12/77
             OVER
ACCOUNT #    CREDIT    ACCOUNT NAME             CURRENT    30-60     60-90    90-120     120+     TOTAL      DEPT.
***************************************************************************************************************

   1          *        JOE BLOW, INC.            400.00    35.95    147.50     0.00     10.95    594.40      050

  10                   ALL GOOD CO.               35.00     0.00      0.00     0.00      0.00     35.00      050

 100                   GOOD OLE GIRLS, INC.      100.00     0.00      0.00    50.00      0.00    150.00      050
              ****     DISPUTED AMOUNTS            0.00     0.00      0.00    50.00      0.00     50.00

1000                   SAMUEL T. CO.              50.00    35.00     75.35     0.00      0.00    160.35      050
                                                -------   ------    ------   ------     -----    ------
                       DEPT. 050 TOTALS          585.00    70.95    222.85     0.00     10.95    889.75

3000                   ACE CARDS                 375.00   450.00    379.00     0.00      0.00   1204.00      060

4000                   SAM                        50.00    25.00      0.00     0.00      0.00     75.00      060
                                                -------  -------    ------   ------    ------  --------
                       DEPT. 060 TOTALS          425.00   475.00    379.00     0.00      0.00   1279.00
                                               ========  ========  =======    =====     =====   =======

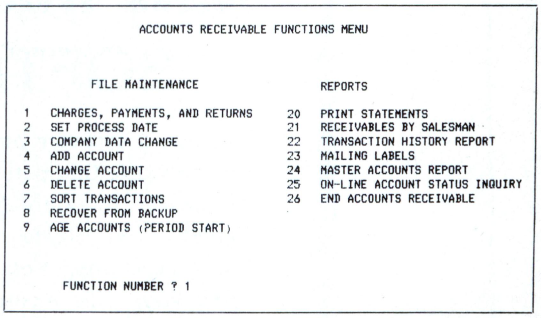
                       COMPANY TOTALS           1010.00   545.95    601.85     0.00     10.95   2168.75
```

The various reports listed in the menu of functions are as indicated with samples of some of these included in this article.

Features

The following is a list of features that are being incorporated into this accounts receivable.

- Multi-company or multi-department
- Up to 500 accounts



```
                 ACCOUNTS RECEIVABLE FUNCTIONS MENU


        FILE MAINTENANCE                         REPORTS

1   CHARGES, PAYMENTS, AND RETURNS      20   PRINT STATEMENTS
2   SET PROCESS DATE                    21   RECEIVABLES BY SALESMAN
3   COMPANY DATA CHANGE                 22   TRANSACTION HISTORY REPORT
4   ADD ACCOUNT                         23   MAILING LABELS
5   CHANGE ACCOUNT                      24   MASTER ACCOUNTS REPORT
6   DELETE ACCOUNT                      25   ON-LINE ACCOUNT STATUS INQUIRY
7   SORT TRANSACTIONS                   26   END ACCOUNTS RECEIVABLE
8   RECOVER FROM BACKUP
9   AGE ACCOUNTS (PERIOD START)


     FUNCTION NUMBER ? 1
```

- Up to a disk full of items per period (4000 for double density floppy)
- Balance forward with details for this invoice period
- Aged Receivables Balance Report (options for only those accounts with balances older than 30, 60, 90, or 120 days)
- Credit-limit warnings
- Receivables by salesman report
- Disputed amount handling and reporting
- Interest or penalty on past-due statements (optional usage)
- Detailed input editing for correctness
- On-line aged account analysis
- On-line posting of accounts
- Cyclic billing capability for statements
- Automatic backup of files with recovery from backup function
- Detailed transaction history for audit and recovery from backup purposes
- Returns and Allowances can be applied to any aged period
- Automatic discount calculations based on individual customers
- Up to four dunning messages for statements
- Up to four custom thanks or advertising lines for statements
- Never print dunning statement for individual customer option

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CIRCLE 131 ON READER SERVICE CARD

- Never-print statement for individual customer option
- Year-to-date totals (billed by account)
- Transaction log report between specified dates
- Mailing-label generation
- Master-accounts report
- Reports sorted by department or company

Specifications

Machine Requirements

Any 8080 or Z80 processor with 32K bytes of memory, two floppy disks or a hard disk running under CP/M, a CRT and a printer. A program is provided to modify the entire system to handle CRTs with cursor controls different from a Hazeltine 1500.

Language

The systems are written in Fortran with an Indexed Sequential Access Method. Therefore they run very fast and efficiently. The system is provided in 8080 object code.

Documentation

Complete users manuals are available for the completed systems. The manuals explain step-by-step use of the systems from start-up to year-end processing. Sample reports and most CRT displays are also provided in the manuals.

License

The software is available under a non-disclosure and non-proliferation license. OEM and dealer licenses are also available.

Maintenance

Any programming errors will be fixed at no charge for a one-year period. Enhancements and modifications will be performed for any user through a per-job fee, although few users are expected to need this service.

Software Subscription Service

A subscription service under which software updates are supplied is available at $100 per year.

Installation and Training

Arkansas Systems, Inc. will supply installation and training support at your location or at theirs for $200 per day plus expenses (at your location). The software and manuals are designed however, to allow easy installation by the user.

Availability

The Accounts Receivable Package is $495 including the software on a floppy with documentation. Users manuals are $15 each with credit toward purchase of the software. An information packet is available free from Arkansas Systems, Inc., 8901 Kanis Road, Suite 206, Little Rock, Ark., 72205, (501) 227-8471. Dealer inquiries are also invited. ■

ACCOUNTS RECEIVABLE:

Computer Data Systems

The Computer Data Systems accounts receivable package was designed to effectively utilize the capabilities of our computer. The package is a low-volume unit with combinations of sequential and random accesses to the files. Information gathered by the package represents the minimum essential inputs for any day-to-day business transaction. To keep the package as general and simple as possible, the user is prompted to respond to menus to obtain the proper input function and statements to enter the specific data required to complete a transaction. We do not make any claims that the Business Pak will solve all business problems or that it will provide reams of perfect information for making decisions, because we don't offer the package for sale. We do believe the package provides good, concise information that can be analyzed for running a more competitive business.

To begin using the Business Pak, you load the MDOS & Basic Pak. Then, insert the Business Pak. To insure you have clean files you type-in PLOADG "Initial". This process takes approximately 5 minutes. You are now ready to begin.

Receivables Mode

The Business Pak is menu driven. In the Receivables section, you can enter an order, update an account, or print a Receivables statement. To enter an order, you answer the menu with a 1. Then you are prompted to enter the date, customer's Account #, Invoice # (an alphanumeric field that is checked for duplication) and finally the total Invoice Amount due. You are then asked if you have another Invoice. If you do, type in Y and repeat the above steps, otherwise, you return to the Receivables menu.

If you wish to update an account, you type in a 2 and another menu appears. This menu asks if you wish to change an Invoice amount, enter a payment, or quit. If you type in 0 for Quit you return to the Receivables menu. Otherwise, you are asked to type in the customer Acct. #. Then the customer's Acct. statement is displayed. You are asked to enter the Invoice # (which is checked for validity). If you want to change the Invoice amount, you are asked to enter the new corrected total and then return to the update menu. If you wanted to enter a payment, you enter the amount, the check # and date of payment. Next, another payment (Y or N)? appears on the screen and if yes, you repeat the above or you return to the update menu.

Hardware

Computer Data Systems computer consists of a Versatile 4 series computer or equivalent with 32K RAM, 9" CRT with a 24x80 video card, one Micropolis floppy disk unit and controller (315K) with Micropolis BASIC. A line printer is optional.

Each computer we sell comes complete with documentation for the unit and the software. The software comes in source code on a single diskette. The Business Pak diskette contains all 15 programs and 6 data file areas. The data files can handle 200 names and addresses, 100 payables items, 100 receivable items, 100 inventory items, 100 cash account items and writing 45 checks. Our manual includes sections on MDOS, BASIC and how to use the Business Pak. This is done to facilitate small changes in the source code if an application does not fit the purchaser's needs.

For further information contact Computer Data Systems, 5460 Fairmont Drive, Wilmington, DE 19808 ■

Computer Data Systems Versatile 4 Dual Drive System

EXAMPLE

Account Statement

Dan Peck
5460 Fairmont Drive
Wilmington, DE 19808

Account # 101

Invoice #	Invoice Date	Invoice Total
CDS 1001	6/22/78	$ 89.00
CDS 1002	6/22/78	$ 267.05
CDS 1003	6/27/78	$ 999.95
CDS 1004	6/27/78	$ 4,465.89
	Total Due =	$ 5,821.89

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CIRCLE 126 ON READER SERVICE CARD

STAR WARS

Thomas N. Ronayne

STARWARS is a BASIC-language computer game of war with a twist: the player may actively participate by playing the game against the computer, or, alternately, the player may function as an uninvolved observer as the "on-board computers" battle against one another; that is, the computer will play against itself. (It's not a good idea to play the game in this manner on a printing terminal — the "computers" play a very conservative game which takes a very long time and gobbles up a great deal of paper!

The game is played in the scenario of the film STARWARS: the players are the characters of the film, the time and place is "long ago in a galaxy far away." The human player assumes the role of Han Solo, mercenary captain of the Millennium Falcon. The computer assumes the role of Darth Vadar, Chief Bad Guy. The Millennium Falcon must reach a goal — Yavin-4 — before the evil force personified by Darth Vadar can destroy it and its occupants. The fate of the entire galaxy hinges on the successful completion of this mission.

There are three obstacles in the path of successful completion of the mission: distance; time; Darth Vadar. First, Yavin-4 is one light-year (9.45426 12 Kilometers) distant. Second, the Millennium Falcon can travel only at 90% light velocity in "normal" space, and, at this velocity, it takes 1.1 years to travel one light year. The Millennium Falcon has only sufficient life-support for one year of travel (365 moves). The third problem is Vadar: he is a hunter-killer, bent on destroying the Millennium Falcon at almost any cost, to save the rather overbearing Galactic Empire from destruction by the Good Guys (the crew of the Millennium Falcon and their buddies). However, Vadar is not suicidal — he will go on R&R if he has to so that he may continue to fight.

Thomas N. Ronayne, 16615 Rosemont Rd., Detroit, MI 48219.

To overcome the time and distance factor, the Millennium Falcon (and Darth Vadar!) can enter "Hyperspace" and travel at greater-than-light velocities. However, this gobbles up wads of power, can only be done for one hour at a time, and only once every two days. Navigation at excess light velocity also tends to be somewhat sloppy, sometimes at right angles to the intended flight path.

Additionally, navigation errors can put the Millennium Falcon in a black hole, star, or other unpleasant circumstances (of course, it would be unfair if the same does not hold true for Vadar; it's just that his chances of having such a calamity befall him are much slimmer than those of the Millennium Falcon). Also, because the computer on board Vadar's ship isn't as smart as the one on the Millennium Falcon, his weapons tend to have better aim and greater success when fired.

As regards light velocity, it is stated in kilometers per second (KPS), and is given as C; C = 299792.5 KPS. The Millennium Falcon is able to travel at .9C, or 269813.25 KPS in normal space and at much higher rates in hyperspace (see the program instructions).

The game can last for a very long time if played in a conservative manner. By taking frequent rests (to build up power), both ships can last to the end of the game. The penalty for running out of power is the same as running out of life support: death.

Note should be made that the most powerful weapon, the laser, has its effectiveness affected by range — the closer together the two ships are, the more effective the laser; however, the laser can't be used except at distances greater than 100,000K (the backsplash would harm the firing ship).

Program Language Notes

The language used in the program is standard BASIC, with the following minor exceptions: The back slant (/) allows more than one statement per line; the SST function extracts the first letter from a string (allowing a YES or NO answer to be Y or N) and, because it cannot be utilized directly in the BASIC that the program was written in, the assignment is to an additional variable. The program was written for a word-oriented machine, operating in eight significant digits — if you go to double precision, you may find the distances more exact. Line-feeds are used inside of quotes — BASIC should allow this in any version because line-feeds are, after all, string characters. If your BASIC will not allow "PRINT USING", just remove the image statement lines, delete the word USING, and format with commas and/or semicolons.

Mostly, have fun.

Line	*Comments*
10	DAT$ is date, CLK$ is time of day
50	The back slant (/) allows multiple statements on one line
90	SST(A1$,1,1) is sub-string extraction: A$ is the string, the first 1 indicates where the extracting starts, the second 1 is the length to be extracted
100	Line Feed, within quotes, is a string, and spaces the carriage (instead of multiple PRINT statements)
710,810	D9 counts the days in transit. Change to D9=D9+5 to speed up game (you are allowed 365 days)
2030	Again, Line Feeds within quotes

Sample Run

```
*RUN


STARWARS        01/06/78   8.739

WHAT IS YOUR NAME?HAN SOLO

DO YOU WISH TO ALLOW THE ON-BOARD COMPUTERS DO BATTLE
AGAINST ONE ANOTHER, HAN SOLO?N


GREETINGS, HAN SOLO, THIS IS DARTH VADAR.  I AM ABOUT TO WIPE
THE FLOOR WITH YOU, BUT, FOR THE SAKE OF SPORT, I WILL GIVE YOU
A SPORTING CHANCE TO DEFEND YOURSELF AND - PERHAPS, THOUGH I SIN-
CERLY DOUBT IT - GET ME INSTEAD.


DO YOU THINK THAT INSTRUCTIONS WILL HELP YOU, HAN SOLO?Y


HISTORY TAPE - DATA LIBRARY: GALDATE 8066  8.749 HOURS.


  YOU ARE CAPTIAN OF THE MILLENNIUM FALCON.  YOU AND YOUR CO-PILOT
THE WOOKIE CHEWBACCA, ARE MERCENARIES  PLYING YOUR TRADE THROUGHOUT
THE GALAXY.
  AFTER TAKING ON FOUR PASSENGERS, LUKE SKYWALKER, BEN (OBI-WAN)
KENOBI, AND TWO 'DROIDS, SEE-THREEPIO AND ARTOO-DETOO, AND ESCAP-
ING THE IMPERIAL FORCES AT MOS EISLEY, IN THE TATOOINE SYSTEM, YOU
HAVE RESCUED THE PRINCESS LEIA ORGANA OF ALDERHAAN FROM THE
CLUTCHES OF THE EVIL GRAND MOFF TARKIN, AND THE DARK LORD OF
THE SITH, DARTH VADAR.
  YOUR MISSION IS TO REACH THE REBEL FORCES BASE LOCATED ON
YAVIN-4.  LORD VADAR IS BETWEEN YOU AND YOUR GOAL.  HIS SHIP
HAS EXACTLY THE SAME ARMMAMENT AS YOURS, AND THE SAME AMOUNT
OF POWER AVAILABLE.  YOU MUST DEFEAT HIM IN ORDER TO REACH SAFETY,
AND DELIVER YOUR PRECIOUS CARGO:
THE PRINCESS LEIA, AND THE DETAILED PLANS OF THE DEATH STAR STORED
IN THE MEMORY CIRCUITS OF THE 'DROID, ARTO-DETOO.

DO YOU WISH FURTHER INFORMATION, HAN SOLO?Y
```

```
YOU ARE BOUND FOR YAVIN-4, WHICH IS ONE LIGHT-YEAR DISTANT
(A LIGHT-YEAR IS EQUAL TO 9.454^12 KILOMETERS).  YOU ARE
ABLE TO TRAVEL AT .9C (C = LIGHT VELOCITY = 299792.5 KPS)
WITH POWER CONSUMED EXACTLY OFFSETTING POWER GENERATED.  HOWEVER,
TRAVELING AT .9C WILL PUT YOU AT YAVIN-4 IN 1.1 YEARS HAN SOLO,
AND YOU HAVE ONLY SUFFICIENT LIFE-SUPPORT CAPABILITES FOR ONE
YEAR OF TRAVEL (CHEWBACCA EATS A LOT).

TO OVERCOME THIS TIME FACTOR, YOU MAY ENTER HYPERSPACE AND TRAVEL
AT A MAXIMUM VELOCITY OF 518,041,440 KPS FOR A PERIOD OF ONE HOUR
AT A TIME.  THEORETICALLY, BY SO DOING, YOU WOULD REACH YOUR GOAL
IN 5.1 HOURS BY TRAVELING CONTINUOUSLY IN HYPERSPACE.  HOWEVER, THE
ENGINES MUST REST AFTER EACH HYPERSPACE JUMP, AND ANY ATTEMPT


TO ENTER HYPERSPACE TWICE IN A ROW RESULTS IN BLOWING UP THE
ENGINES, LEAVING YOU STUCK IN HYPERSPACE FOREVER.
A HYPERSPACE JUMP USES A GREAT DEAL OF ENERGY  VARYING BY A POWER
OF THE HYPERFACTOR [HF] SELECTED.  JUMPS ARE SPECIFIED FROM HF-1,
1.0C TO HF-12, 1728C.
THESE ARE AS FOLLOWS:

          H-F    1  VELOCITY   299792.5      KPS
          H-F    2  VELOCITY 2398340         KPS
          H-F    3  VELOCITY 8094398         KPS
          H-F    4  VELOCITY 1.91867e 07     KPS
          H-F    5  VELOCITY 3.74741e 07     KPS
          H-F    6  VELOCITY 6.47552e 07     KPS
          H-F    7  VELOCITY 1.02829e 08     KPS
          H-F    8  VELOCITY 1.53494e 08     KPS
          H-F    9  VELOCITY 2.18549e 08     KPS
          H-F   10  VELOCITY 2.99793e 08     KPS
          H-F   11  VELOCITY 3.99024e 08     KPS
          H-


            F   12  VELOCITY 5.18041e 08     KPS


HYPERDRIVE CONSUMES ENERGY AT A MINIMUM OF 10,000 UNITS AND A
MAXIMUM OF 21,074 UNITS, AS FOLLOWS:

          HF -  1     POWER CONSUMED - 10000 UNITS
          HF -  2     POWER CONSUMED - 12311 UNITS
          HF -  3     POWER CONSUMED - 13904 UNITS
          HF -  4     POWER CONSUMED - 15157 UNITS
          HF -  5     POWER CONSUMED - 16207 UNITS
          HF -  6     POWER CONSUMED - 17118 UNITS
          HF -  7     POWER CONSUMED - 17928 UNITS
          HF -  8     POWER CONSUMED - 18661 UNITS
          HF -  9     POWER CONSUMED - 19332 UNITS
          HF - 10     POWER CONSUMED - 19953 UNITS
          HF - 11     POWER CONSUMED - 20531 UNITS
          HF - 12     POWER CONSUMED - 21074 UNITS

HYPERSPACE NAVIGATION TENDS TO BE SOMEWHAT ERRATIC, RESULTING
IN NAVIGATION ERRORS; THE HIGHER THE HF, THE GREATER THE
POTENTIAL ERROR.

DO YOU WISH ARMMAMENT INFORMATION  HAN SOLO?Y


                              HERE ARE YOUR VITAL DATUM:

     YOU ARE EQUIPPED WITH 100,000 UNITS OF ENERGY.

WHEN YOU RUN OUT, HAN SOLO  DARTH VADAR WILL DESTROY YOU.


                         ARMMAMENT:

TYPE      DESCRIPTION         RANGE (KILOMETERS)  FUEL DRAIN
  1       HEAVY GUNS          0 - 11000           10 UNITS
  2       WARHEADS            10,000-100,000      100 UNITS
  3       LASER               100,000-200,000     1,000 UNITS


                         OPTIONS
  4       APPROACH                                100 UNITS
  5       RETREAT                                 100 UNITS
  6       WE WILL CONTINUE TO TRAVEL TOWARD YAVIN-4 AT .9C
          AND GAIN ENERGY, ALTHOUGH WE ARE VULNERABLE TO ATTACK.
  7       ENTER HYPERSPACE.
```

```
                         ENEMY:
   THE ENEMY HAS THE SAME CAPABILITIES THAT YOU HAVE.

EACH TIME A SHIP IS HIT, THE ENERGY DRAIN FROM THE SCREENS
IS EQUAL TO THE AMOUNT OF ENERGY EXPENDED BY THE STRIKING
WEAPON TIMES 10 (EXCEPT LASERS, WHICH ARE EQUAL TO AN
EXPENDITURE THAT VARIES WITH DISTANCE TO TARGET).


NOTE: YOU ARE CONTINUALLY BEING DRAWN TOWARD YOUR OPPONENT, WATCH
YOUR RANGE CLOSLY, HAN SOLO!

THIS IS COMPUTER CONTROL.


WE ARE LEAVING PLANETARY ORBIT, HAN SOLO
VADAR APPROACHING AT  181334 KILOMETERS.
DISTANCE TO YAVIN-4 IS 9.45426e 12    KILOMETERS.


MAY THE FORCE BE WITH YOU, HAN SOLO.




WHAT ARE YOUR INSTRUCTIONS, HAN SOLO?3

LASER FIRED  . MAYBE . MISSED . .PHOOEY.



         ENEMY SHIP INTELLIGENCE REPORT:
RANGE:  181334                 POWER:  100000

ENEMY SHIP APPROACHING HAN SOLO


         STATUS OF MILLENNIUM FALCON:
RANGE:  161822                 POWER:   99000
DISTANCE TO YAVIN-4 9.43094e 12    KILOMETERS
DAYS IN TRANSIT:    2  HYPER-JUMPS:    0


WHAT ARE YOUR INSTRUCTIONS, HAN SOLO?3

LASER FIRED  I THINK   .I THINK . . . MAYBE . MISSED . .PHOOEY.



         ENEMY SHIP INTELLIGENCE REPORT:
RANGE:  161822                 POWER:   99900

ENEMY FIRES LASER   . .SCREENS AT FULL POWER . . . .OOOFF . . THEY GOT US!


         STATUS OF MILLENNIUM FALCON:
RANGE:  158585                 POWER:   96854
DISTANCE TO YAVIN-4 9.40763e 12    KILOMETERS
DAYS IN TRANSIT:    3  HYPER-JUMPS:    0


WHAT ARE YOUR INSTRUCTIONS, HAN SOLO?3

LASER FIRED  . MAYBE .GOT 'EM . . . .GOOD SHOOTING, HAN SOLO!

ENEMY FIRES LASER . . .UH-OH   . . .MISSED . .WHEW!


         STATUS OF MILLENNIUM FALCON:
RANGE:  155413                 POWER:   95854


WHAT ARE YOUR INSTRUCTIONS, HAN SOLO?7
PLEASE INDICATE HYPER-FACTOR?10
COMPUTING COURSE AT HF:   10
ENEMY FOLLOWED US THROUGH
```

```
ENEMY WARHEAD IS LAUNCHED . . . .HIT . .OUR POWER DOWN.


          STATUS OF MILLENNIUM FALCON
RANGE    28406                  POWER:   74902


WHAT ARE YOUR INSTRUCTIONS, HAN SOLO?7
PLEASE INDICATE HYPER-FACTOR?10
COMPUTING COURSE AT HF:   10

ENEMY SHIP APPROACHING HAN SOLO


          STATUS OF MILLENNIUM FALCON:
RANGE:  161822                  POWER:   99000
DISTANCE TO YAVIN-4 9.43094e 12    KILOMETERS
DAYS IN TRANSIT:    2  HYPER-JUMPS:    0


WHAT ARE YOUR INSTRUCTIONS, HAN SOLO?3

LASER FIRED  I THINK   .I THINK . . . MAYBE . MISSED . .PHOOEY.



          ENEMY SHIP INTELLIGENCE REPORT:
RANGE:  161822                  POWER:   99900

ENEMY FIRES LASER   . .SCREENS AT FULL POWER . . . .OOOFF . . THEY GOT US!


          STATUS OF MILLENNIUM FALCON:
RANGE:  158585                  POWER:   96854
DISTANCE TO YAVIN-4 9.40763e 12    KILOMETERS
DAYS IN TRANSIT:    3  HYPER-JUMPS:    0


WHAT ARE YOUR INSTRUCTIONS, HAN SOLO?3

LASER FIRED  . MAYBE .GOT 'EM . . . .GOOD SHOOTING, HAN SOLO!

ENEMY FIRES LASER . . .UH-OH   . . .MISSED . .WHEW!


          STATUS OF MILLENNIUM FALCON:
RANGE:  155413                  POWER:   95854


WHAT ARE YOUR INSTRUCTIONS, HAN SOLO?7
PLEASE INDICATE HYPER-FACTOR?10
COMPUTING COURSE AT HF:   10
ENEMY FOLLOWED US THROUGH


ENEMY WARHEAD IS LAUNCHED . . . .HIT . .OUR POWER DOWN.


          STATUS OF MILLENNIUM FALCON
RANGE    28406                  POWER:   74902


WHAT ARE YOUR INSTRUCTIONS, HAN SOLO?7
PLEASE INDICATE HYPER-FACTOR?10
COMPUTING COURSE AT HF:   10

YOU HAVE JUST ENTERED HYPERSPACE TWICE . .ENGINES BLOWN . .
WE'RE STUCK HERE FOREVER!
HAN SOLO THAT WAS A PRETTY DUMB THING FOR YOU TO DO   YOUR
MISSION WAS TO DELIVER YOUR PASSENGERS AND THE VITAL INFORMATION
TO YAVIN-4  NOT GET EVERYBODY KILLED.

WHAT A NERD.

PLAY AGAIN?Y

DO YOU WISH TO ALLOW THE ON-BOARD COMPUTERS DO BATTLE
AGAINST ONE ANOTHER, HAN SOLO?Y


WE ARE LEAVING PLANETARY ORBIT, HAN SOLO,
VADAR APPROACHING AT   42108 KILOMETERS.
DISTANCE TO YAVIN-4 IS 9.45426e 12    KILOMETERS.


MAY THE FORCE BE WITH YOU, HAN SOLO.



WE HAVE LAUNCHED A WARHEAD ENEMY MANEUVERING GOT HIM!


ENEMY WARHEAD IS LAUNCHED . . . .HIT . .OUR POWER DOWN.


          STATUS OF MILLENNIUM FALCON:
RANGE:   41265                  POWER:   98900

WE HAVE LAUNCHED A WARHEAD  HE IS TRYING TO AVOID . .GOT HIM!


ENEMY WARHEAD IS LAUNCHED . . . .HIT . .OUR POWER DOWN.


          STATUS OF MILLENNIUM FALCON:
RANGE:   40439                  POWER:   97800

WE HAVE LAUNCHED A WARHEAD ENEMY MANEUVERING GOT HIM!
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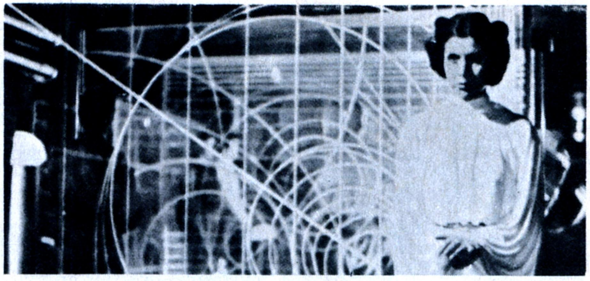

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ENEMY WARHEAD IS LAUNCHED . . . .HIT . .OUR POWER DOWN.


          STATUS OF MILLENNIUM FALCON:
RANGE:   39630                  POWER    96700

WE HAVE LAUNCHED A WARHEAD  HE IS TRYING TO AVOID . .GOT HIM!

ENEMY WARHEAD IS LAUNCHED . . . .HIT . .OUR POWER DOWN.


          STATUS OF MILLENNIUM FALCON
RANGE:   38837                  POWER:   95600

WE HAVE LAUNCHED A WARHEAD  HE IS TRYING TO AVOID . .GOT HIM!


ENEMY WARHEAD IS LAUNCHED . . . . MISSED . .HA!


          STATUS OF MILLENNIUM FALCON:
RANGE:   38060                  POWER:   95500
DISTANCE TO YAVIN-4 8.89646e 12    KILOMETERS
DAYS IN TRANSIT     4  HYPER-JUMPS:    2

WE HAVE LAUNCHED A WARHEAD ENEMY MANEUVERING GOT HIM!


ENEMY WARHEAD IS LAUNCHED . . . .HIT . .OUR POWER DOWN.


          STATUS OF MILLENNIUM FALCON:
RANGE:   37298                  POWER:   94400

WE HAVE LAUNCHED A WARHEAD  HE IS TRYING TO AVOID . .GOT HIM!


ENEMY WARHEAD IS LAUNCHED . . . . MISSED . .HA!


          STATUS OF MILLENNIUM FALCON:
RANGE:   36552                  POWER:   94300
DISTANCE TO YAVIN-4 8.76259e 12    KILOMETERS
DAYS IN TRANSIT:    5  HYPER-JUMPS:    2

ENTERING HYPERSPACE
COMPUTING COURSE AT HF:    6
ENEMY FOLLOWED US THROUGH



ENEMY FIRES LASER . . .SCREENS AT FULL POWER . . . .OOOFF . . THEY GOT US!


          STATUS OF MILLENNIUM FALCON:
RANGE:  122240                  POWER:   74924
DISTANCE TO YAVIN-4 8.50716e 12    KILOMETERS
DAYS IN TRANSIT:    6  HYPER-JUMPS:    3

LASER FIRED  I THINK . .I THINK . . . MAYBE . MISSED . .PHOOEY.

          ENEMY SHIP INTELLIGENCE REPORT:
RANGE:  122240                  POWER    74182

ENEMY FIRES LASER . . .SCREENS AT FULL POWER . . . .OOOFF . . THEY GOT US!


          STATUS OF MILLENNIUM FALCON:
RANGE:  119795                  POWER    71591
DISTANCE TO YAVIN-4 8.46253e 12    KILOMETERS
DAYS IN TRANSIT:    7  HYPER-JUMPS:    3

LASER FIRED  I THINK . .I THINK . . . MAYBE . MISSED . .PHOOEY.



          ENEMY SHIP INTELLIGENCE REPORT
RANGE:  119795                  POWER:   73182

ENEMY FIRES LASER . . .SCREENS AT FULL POWER . . . .OOOFF . . THEY GOT US!


          STATUS OF MILLENNIUM FALCON:
RANGE:  117399                  POWER:   68185

LASER FIRED  I THINK . .I THINK . . . MAYBE . MISSED . .PHOOEY.
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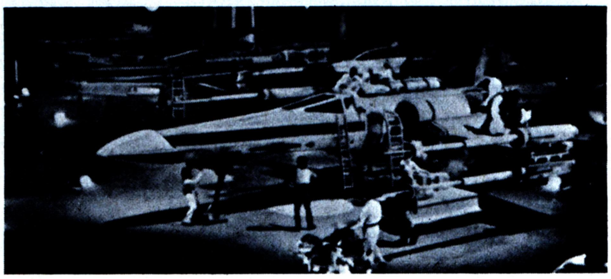

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          ENEMY SHIP INTELLIGENCE REPORT:
RANGE:  117399                  POWER:   72182

ENEMY FIRES LASER . . .UH-OH   . . .MISSED . .WHEW!


          STATUS OF MILLENNIUM FALCON:
RANGE:  115051                  POWER:   67185
DISTANCE TO YAVIN-4 8.39560e 12    KILOMETERS
DAYS IN TRANSIT:    8  HYPER-JUMPS     3

ENTERING HYPERSPACE
COMPUTING COURSE AT HF:    9
ENEMY FOLLOWED US THROUGH


ENEMY WARHEAD IS LAUNCHED . . . .HIT . .OUR POWER DOWN.


          STATUS OF MILLENNIUM FALCON:
RANGE:   17280                  POWER:   46853

WE HAVE LAUNCHED A WARHEAD  HE IS TRYING TO AVOID . . MISSED. .DRAT!
```

Program Listing

```
10 PRINT "STARWARS";TAB(15);DAT$;TAB(25);CLK$
20 REM
30 REM BY T. N. RONAYNE. 16615 ROSEMONT ROAD  DETROIT, MI 48219
40 REM
50 DIM P(1)\Q = 1
60 PRINT "
         WHAT IS YOUR NAME";\INPUT A$
70 PRINT "
         DO YOU WISH TO ALLOW THE ON-BOARD COMPUTERS DO BATTLE"
80 PRINT "AGAINST ONE ANOTHER, ";A$;\INPUT A1$
90 A2$ = SST(A1$,1,1)\ IF A2$ ="Y" THEN 630
100 PRINT "

          GREETINGS, ";A$;", THIS IS DARTH VADAR.  I AM ABOUT TO WIPE"
110 PRINT "THE FLOOR WITH YOU, BUT, FOR THE SAKE OF SPORT, I WILL GIVE YOU"
120 PRINT "A SPORTING CHANCE TO DEFEND YOURSELF AND - PERHAPS, THOUGH I SIN-"
130 PRINT "CERLY DOUBT IT - GET ME INSTEAD."
140 PRINT "

          DO YOU THINK THAT INSTRUCTIONS WILL HELP YOU. ";A$;\INPUT B$
150 IF B$ = "N" THEN 380\IF B$ = "NO" THEN 380
160 PRINT"

         HISTORY TAPE - DATA LIBRARY: GALDATE";INT(RND(-1) * 100 + 8000);
170 PRINT CLK$;" HOURS."
180 PRINT\PRINT
190 PRINT "  YOU ARE CAPTIAN OF THE MILLENNIUM FALCON.  YOU AND YOUR CO-PILOT,"
200 PRINT "THE WOOKIE CHEWBACCA, ARE MERCENARIES, PLYING YOUR TRADE THROUGHOUT"
210 PRINT "THE GALAXY."
220 PRINT "  AFTER TAKING ON FOUR PASSENGERS, LUKE SKYWALKER, BEN (OBI-WAN)"
230 PRINT "KENOBI, AND TWO 'DROIDS, SEE-THREEPIO AND ARTOO-DETOO  AND ESCAP-"
240 PRINT "ING THE IMPERIAL FORCES AT MOS EISLEY, IN THE TATOOINE SYSTEM  YOU"
250 PRINT "HAVE RESCUED THE PRINCESS LEIA ORGANA OF ALDERHAAN FROM THE"
260 PRINT "CLUTCHES OF THE EVIL GRAND MOFF TARKIN. AND THE DARK LORD OF"
270 PRINT "THE SITH. DARTH VADAR."
280 PRINT "  YOUR MISSION IS TO REACH THE REBEL FORCES BASE LOCATED ON"
290 PRINT "YAVIN-4.  LORD VADAR IS BETWEEN YOU AND YOUR GOAL.  HIS SHIP"
300 PRINT "HAS EXACTLY THE SAME ARMMAMENT AS YOURS, AND THE SAME AMOUNT"
310 PRINT "OF POWER AVAILABLE.  YOU MUST DEFEAT HIM IN ORDER TO REACH SAFETY,"
320 PRINT "AND DELIVER YOUR PRECIOUS CARGO:"
330 PRINT "THE PRINCESS LEIA, AND THE DETAILED PLANS OF THE DEATH STAR STORED"
340 PRINT "IN THE MEMORY CIRCUITS OF THE 'DROID, ARTO-DETOO."
350 PRINT "
          DO YOU WISH FURTHER INFORMATION  ";A$;\INPUT B$
360 IF B$ = "N" THEN 380\ IF B$ = "NO" THEN 380
370 GOSUB 2210
380 PRINT "
          DO YOU WISH ARMMAMENT INFORMATION  ";A$;\INPUT B$
390 IF B$ = "N" THEN 620\IF B$ = "NO" THEN 620
400 PRINT TAB(30);"


                    HERE ARE YOUR VITAL DATUM:"
410 PRINT\PRINT TAB(5);"YOU ARE EQUIPPED WITH 100,000 UNITS OF ENERGY."
420 PRINT "
          WHEN YOU RUN OUT, ";A$.", DARTH VADAR WILL DESTROY YOU."

430 PRINT TAB(30);"

                    ARMMAMENT:"
440 PRINT "TYPE";TAB(10);"DESCRIPTION";TAB(30);"RANGE (KILOMETERS)";TAB(50);"FUEL DRAIN"
450 PRINT "  1";TAB(10);"HEAVY GUNS";TAB(30);"0 - 11000";TAB(50);"10 UNITS"
460 PRINT "  2";TAB(10);"WARHEADS" TAB(30);"10,000-100,000";TAB(50);"100 UNITS"
470 PRINT"  3";TAB(10);"LASER";TAB(30);"100,000-200,000";TAB(50);"1,000 UNITS"
480 PRINT\PRINT\PRINT TAB(25);"OPTIONS"
490 PRINT "  4";TAB(10);"APPROACH";TAB(50);"100 UNITS"
500 PRINT "  5";TAB(10);"RETREAT";TAB(50);"100 UNITS"
510 PRINT "  6";TAB(10);"WE WILL CONTINUE TO TRAVEL TOWARD YAVIN-4 AT .9C"
520 PRINT TAB(10);"AND GAIN ENERGY, ALTHOUGH WE ARE VULNERABLE TO ATTACK."
530 PRINT "  7";TAB(10);"ENTER HYPERSPACE."
540 PRINT TAB(25);"



                    ENEMY:"
550 PRINT "THE ENEMY HAS THE SAME CAPABILITIES THAT YOU HAVE "
560 PRINT "



          EACH TIME A SHIP IS HIT, THE ENERGY DRAIN FROM THE SCREENS"
570 PRINT "IS EQUAL TO THE AMOUNT OF ENERGY EXPENDED BY THE STRIKING"
580 PRINT "WEAPON TIMES 10 (EXCEPT LASERS, WHICH ARE EQUAL TO AN"
590 PRINT "EXPENDITURE THAT VARIES WITH DISTANCE TO TARGET)."
600 PRINT "

          NOTE. YOU ARE CONTINUALLY BEING DRAWN TOWARD YOUR OPPONENT  WATCH"
610 PRINT "YOUR RANGE CLOSLY  " A$ "!"
620 PRINT "
          THIS IS COMPUTER CONTROL."
630 B1 = 9.454256E12
640 P = 100000\P(1) = 100000\A = INT(RND(-1) * 200000)
650 PRINT "

          WE ARE LEAVING PLANETARY ORBIT, " A$ ", "
660 PRINT "VADAR APPROACHING AT";A "KILOMETERS."
670 PRINT "DISTANCE TO YAVIN-4 IS";B1;"KILOMETERS."
680 PRINT "

          MAY THE FORCE BE WITH YOU, " A$,"."
690 PRINT\PRINT\PRINT
700 IF A2$ <> "Y" THEN 800
710 D9 = D9 + 1\O = INT(RND(-1) * 2 + 1)
720 C = INT(RND(-1) * 3.14159 * (RND(-1) * 3.14159))
730 IF A > 200050 THEN 1410\IF C = 0 THEN 720\IF A > 50000 THEN 750
740 IF C = 4 THEN 720
750 IF C = 4 THEN 720\IF C = 5 THEN 720\IF C <> 6 THEN 770
760 IF P > 5000 THEN 720
770 IF C < 7 THEN 780\IF C = 7 THEN 790\IF C > 7 THEN 720
780 N = 0\B1 = B1 - (2.231186E10)\GOTO 880
790 IF N > 0 THEN 720\GOTO 880
800 PRINT "

          WHAT ARE YOUR INSTRUCTIONS, ";A$;\INPUT C
810 D9 = D9 + 1
820 O = INT(RND(-1) * 2 + 1)
830 IF A > 200050 THEN 840\GOTO 850
840 IF C < 6 THEN 1090
850 IF C<7 THEN 860\IF C = 7 THEN 880
860 N = 0
870 B1 = B1 - (2.331186E10)
880 IF C = 1 THEN 1100\IF C = 2 THEN 1180\IF C = 3 THEN 1250
890 IF C = 4 THEN 1310\IF C = 5 THEN 1350\IF C = 6 THEN 1410
900 IF A2$ <> "Y" THEN 950
910 H = INT(RND(-1) * 10 + 1)
920 IF P - (10000 * H^.3) < 500 THEN 720
930 IF H = 0 THEN 910
940 PRINT "
          ENTERING HYPERSPACE"\GOTO 970
950 IF C>7 THEN 1080\PRINT "PLEASE INDICATE HYPER-FACTOR";\INPUT H
960 IF H < 13 THEN 970\GOTO 950
970 P = P - (10000 * (H^.3))\N = N + 1\PRINT "COMPUTING COURSE AT HF:";H
980 H9 = H9 + 1
990 IF P < 100 THEN 1890\IF B1 -((H^3 * 299792.5) * 60^2) < 1E6 THEN 1780
1000 IF N>1 THEN 1870\A = A + ((H^3 * 299792.5) * 60^2)\IF O = 1 THEN 2140
1010 O2 = INT(RND(-1) * 3.1415926 + 1)\IF O2 = 1 THEN 2140\IF O2 = 4 THEN 2120
1020 B1 = B1-((H^3 * 299792.5) * (INT(3.14159^3 * RND(-1) + 29)^2))
1030 PRINT "SORRY, NAVIGATION ERROR PUT US OFF LINE."\IF O2 = 3 THEN 1060
1040 IF P(1) - (H^.3 * 10000) < 10000 THEN 1480
1050 PRINT"HE FOLLOWED!"\P(1)=P(1)-(10000*(H^.3))\A=INT(RND(-1)*200000)\GOTO 1420
1060 PRINT "NO SIGN OF ENEMY, CRUISING AT .9C."\B1 = B1 - (2.33118E10)
1070 IF B1 < 1E5 THEN 1960\GOTO 1720
1080 IF A2$ <> "Y" THEN 1090\GOTO 700
1090 PRINT A$;", LET'S NOT CRACK UNDER PRESSURE, CHECK YOUR RANGE!."\GOTO 700
1100 IF A > 11005 THEN 1080
1110 P = P - 10\PRINT "
                    GUNS HAVE BEEN FIRED . .";
1120 IF O = 1 THEN 1130\PRINT" ENEMY MANEUVERING TO AVOID"\GOTO 1140
1130 PRINT" AWAITING DAMAGE ASSESSMENT. .";
1140 IF O = 1 THEN 1160
1150 PRINT " MISSED - DRAT!"\GOTO 1420
1160 PRINT " HIT - - HIS POWER IS DOWN."
1170 P(1) = P(1) - 100 \ GOTO 1420
1180 IF A > 100000 THEN 1080\IF A < 10000 THEN 1080
1190 P = P - 100\PRINT "
                    WE HAVE LAUNCHED A WARHEAD ";\O1 = INT(RND(-1) * 2) + 1
1200 IF O1 = 1 THEN 1210\PRINT "ENEMY MANEUVERING ";\GOTO 1220
1210 PRINT " HE IS TRYING TO AVOID . .";
1220 IF O = 1 THEN 1230\PRINT " MISSED. .DRAT!"\GOTO 1420
1230 PRINT "GOT HIM!"
1240 P(1) = P(1) - 1000\GOTO 1420
1250 IF A < 100000 THEN 1080\P = P - 1000\PRINT "
                                        LASER FIRED "
1260 O1 = INT(RND(-1) * 2 + 1)
1270 IF O1 = 1 THEN 1280\PRINT " I THINK . .I THINK . ."
1280 PRINT " . MAYBE .";\IF O = 1 THEN 1290\PRINT " MISSED . .PHOOEY."\GOTO 1420
1290 PRINT "GOT 'EM . . . .GOOD SHOOTING, ";A$,"!"
1300 P(1) = P(1) - (((200000 - A)/1E5)*3000)\GOTO 1450
1310 PRINT "
```

```
            APPROACHING, ";A$
1320 B = INT(RND(-1) * 40000 + 10000)\A = A - B\P = P - 100\IF A < 1 THEN 1340
1330 GOTO 1420
1340 PRINT TAB(30);">COLLISION<"\PRINT "
                                        BOTH SHIPS DESTROYED . ."\GOTO 1900
1350 PRINT "
            RETREATING  ";A$
1360 B = RND(-1) * 40000 + 10000\A = A + B\P = P - 100\ IF A > 200050 THEN 1380
1370 GOTO 1420
1380 PRINT A$;" YOUR RANGE IS" A;", BUT WE CANNOT RUN  RANGE IS NOW 200,000"
1390 A = 200000
1400 IF O1 = 1 THEN 1820\GOTO 1420
1410 PRINT "
            RESTING. ";A$\P = P + 1000
1420 PRINT\PRINT\IF O = 1 THEN 1450
1430 PRINT TAB(10);"

                    ENEMY SHIP INTELLIGENCE REPORT:"
1440 PRINT "RANGE:";INT(A);TAB(30);"POWER:";INT(P(1))
1450 IF A > 200050 THEN 1480
1460 IF P(1) < 100 THEN 1950\IF P(1) < 5000 THEN 1800\IF A > 175000 THEN 1820
1470 IF A < 5000 THEN 1850\GOTO 1520
1480 IF P(1) - (10000 * H^.3) < 2000 THEN 1800
1490 P(1) = P(1) - (10000 * H^.3)\O1 = INT(RND(-1) * 3.14159 + 1)
1500 PRINT "
            VADAR HAS ENTERED HYPERSPACE . .";\IF O1 = 4 THEN 2110
1510 A = INT(RND(-1) * 40000 + 10000)\PRINT " IS ON US!"
1520 IF B1 < 1.5E6 THEN 1960
1530 R = INT(RND(-1) * 3.14159 + 1)\O = INT(RND(-1) * 2 + 1)
1540 IF R = 1 THEN 1660\IF R = 2 THEN 1620\IF R = 4 THEN 1810
1550 IF A < 100000 THEN 1530\P(1) = P(1) - 1000
1560 PRINT "
            ENEMY FIRES LASER . . .";
1570 O1 = INT(RND(-1) * 2 + 1)\IF O1 = 1 THEN 1580\PRINT "UH-OH . ." \GOTO 1590
1580 PRINT "SCREENS AT FULL POWER . .";
1590 IF O1 = 1 THEN 1600\PRINT " . .MISSED . .WHEW!"\GOTO 1720
1600 IF O1 = 2 THEN 1610\PRINT "   .OOOFF . .";
1610 PRINT " THEY GOT US!"\P=P-(((200000-A)/1E5)*3000)\GOTO 1720
1620 IF A > 100000 THEN 1530\IF A < 10000 THEN 1530
1630 P(1) = P(1) - 100\PRINT "ENEMY WARHEAD IS LAUNCHED . .";
1640 IF O = 1 THEN 1650\PRINT " . . MISSED . .HA!"\GOTO 1720
1650 P = P - 1000\PRINT " . .HIT . .OUR POWER DOWN "\GOTO 1720
1660 IF A > 11000 THEN 1530\P(1) = P(1) - 10\PRINT "ENEMY HAS FIRED A SHELL ";
1670 PRINT "I AM ATTEMPTING TO AVOID . .";
1680 IF O = 1 THEN 1710\PRINT " MISSED!"
1690 IF O1 = 1 THEN 1720\PRINT "THAT'LL SHOW YOU WHAT CLEAN LIVING DOES ";
1700 PRINT "FOR YOU, ";A$ " "\GOTO 1720
1710 PRINT "DIRECT HIT!!!     POWER DOWN!"\P = P - 100
1720 PRINT TAB(10) "

                    STATUS OF MILLENNIUM FALCON "
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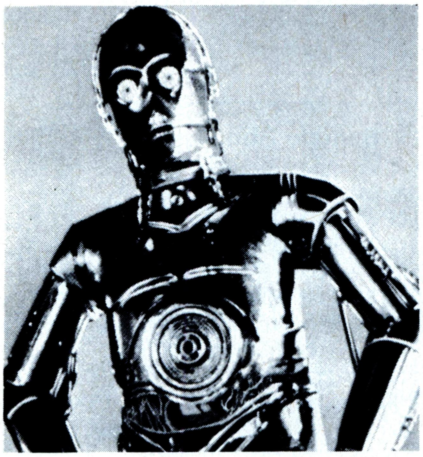

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1730 A = INT(A * .98)
1740 PRINT "RANGE:";INT(A);TAB(30);"POWER " INT(P)\IF P < 1 THEN 2000
1750 IF O = 1 THEN 1770\PRINT "DISTANCE TO YAVIN-4";B1,"KILOMETERS"
1760 Q=Q+1\PRINT "DAYS IN TRANSIT:";D9;" HYPER-JUMPS ";H9
1770 IF D9 >= 365 THEN 1990\IF B1 > 1E6 THEN 1790
1780 IF O = 1 THEN 1960\PRINT "WE ARE GOING TO COLLIDE WITH YAVIN-4!"\GOTO 1900
1790 GOTO 700
1800 P(1) = P(1) + 1000\PRINT "
                               ENEMY SHIP RESTING."\GOTO 1720
1810 IF A < 150000 THEN 1530\IF A > 200050 THEN 1450
1820 B = RND(-1) * 40000 + 10000\A = A - B\PRINT "
                                                  ENEMY SHIP APPROACHING ";A$
1830 P(1) = P(1) - 100
1840 GOTO 1720
1850 B = RND(-1) * 40000 + 10000\A = A + B\PRINT "
                                                  ENEMY SHIP RETREATING ",A$
1860 P(1) = P(1) - 100\GOTO 1720
1870 PRINT "YOU HAVE JUST ENTERED HYPERSPACE TWICE   .ENGINES BLOWN . ."
1880 PRINT "WE'RE STUCK HERE FOREVER!"\GOTO 1900
1890 PRINT "YOU JUST HYPERED AWAY ALL OF OUR POWER . . ."
1900 PRINT A$;" THAT WAS A PRETTY DUMB THING FOR YOU TO DO.  YOUR"
1910 PRINT "MISSION WAS TO DELIVER YOUR PASSENGERS AND THE VITAL INFORMATION"
1920 PRINT "TO YAVIN-4  NOT GET EVERYBODY KILLED."
1930 PRINT "
            WHAT A NERD."
```

```
1940 GOTO 2040
1950 PRINT "ENEMY SHIP'S POWER GONE . .NO LIFE FORMS PRESENT."\GOTO 1980
1960 PRINT "HA, HA!  VADAR GOT TOO CLOSE TO OUR HIDDEN BASE.  GROUND"
1970 PRINT "BASED HEAVY LASERS HAVE DESTROYED HIS SHIP."
1980 PRINT "MISSION SUCESSFUL"\GOTO 2100
1990 PRINT "WE HAVE BEEN IN TRANSIT FOR MORE THAN ONE YEAR"
2000 PRINT TAB(50);"DARTH VADAR IS THE VICTOR.."\PRINT"LIFE SUPPORT FUNCTIONS";
2010 PRINT "GONE";
2020 PRINT ". .LIFE SUPPORT FADING. ."
2030 PRINT "  C
               R
                E
                 W
                    D
                     I
                      E
                       I
                        N
                         G

                           .
                            .
                             .
                              .
                               .
                                .
                                 ."
2040 PRINT
2050 PRINT
2060 PRINT
2070 PRINT
2080 PRINT "PLAY AGAIN"
2090 INPUT B$\N = 0\IF B$ = "Y" THEN 70\IF B$ = "YES" THEN 70
2100 STOP
2110 PRINT "HE IS BEING SUCKED INTO A BLACK HOLE!"\GOTO 1980
2120 PRINT "OOPS . .WE ARE BEING SUCKED INTO A BLACK HOLE   .SORRY ";
2130 PRINT "ABOUT THAT."\GOTO 2030
2140 O2 = INT(RND(-1) * 3 14159 + 1)\B1 = B1 -((H^3 * 299792.5) * (60^2))
2150 IF B1 < 1E6 THEN 2120
2160 IF P(1) - (H^.3 * 10000) < 10000 THEN 1480
2170 PRINT "ENEMY FOLLOWED US THROUGH"
2180 P(1) = P(1) - (10000 * (H^.3))\A = INT(RND(-1) * 200000)\IF O2 = 4 THEN 2200
2190 GOTO 1420
2200 P = P + 1000\P(1) = P(1) + 1000\GOTO 1720
2210 PRINT "
            YOU ARE BOUND FOR YAVIN-4, WHICH IS ONE LIGHT-YEAR DISTANT"
2220 PRINT "(A LIGHT-YEAR IS EQUAL TO 9.454^12 KILOMETERS).  YOU ARE"
2230 PRINT "ABLE TO TRAVEL AT .9C (C = LIGHT VELOCITY = 299792.5 KPS)"
2240 PRINT "WITH POWER CONSUMED EXACTLY OFFSETTING POWER GENERATED   HOWEVER,"
2250 PRINT "TRAVELING AT .9C WILL PUT YOU AT YAVIN-4 IN 1.1 YEARS ";A$;","
2260 PRINT "AND YOU HAVE ONLY SUFFICIENT LIFE-SUPPORT CAPABILITES FOR ONE"
2270 PRINT "YEAR OF TRAVEL (CHEWBACCA EATS A LOT)."
2280 PRINT
2290 PRINT "TO OVERCOME THIS TIME FACTOR, YOU MAY ENTER HYPERSPACE AND TRAVEL"
2300 PRINT "AT A MAXIMUM VELOCITY OF 518,041,440 KPS FOR A PERIOD OF ONE HOUR"
2310 PRINT "AT A TIME.  THEORETICALLY, BY SO DOING, YOU WOULD REACH YOUR GOAL"
2320 PRINT "IN 5.1 HOURS BY TRAVELING CONTINUOUSLY IN HYPERSPACE.  HOWEVER, THE"
2330 PRINT "ENGINES MUST REST AFTER EACH HYPERSPACE JUMP, AND ANY ATTEMPT"
2340 PRINT "TO ENTER HYPERSPACE TWICE IN A ROW RESULTS IN BLOWING UP THE "
2350 PRINT "ENGINES, LEAVING YOU STUCK IN HYPERSPACE FOREVER "
2360 PRINT "A HYPERSPACE JUMP USES A GREAT DEAL OF ENERGY, VARYING BY A POWER"
2370 PRINT "OF THE HYPERFACTOR [HF] SELECTED   JUMPS ARE SPECIFIED FROM HF-1,"
2380 PRINT "1.0C TO HF-12, 1728C."
2390 PRINT "THESE ARE AS FOLLOWS:"
2400 PRINT
2410 FOR I = 1 TO 12
2420 PRINT TAB(10);"H-F";I TAB(20) "VELOCITY" 299792 5*I^3;TAB(45);"KPS"
2430 NEXT I\PRINT
2440 PRINT\PRINT "HYPERDRIVE CONSUMES ENERGY AT A MINIMUM OF 10,000 UNITS AND A"
2450 PRINT "MAXIMUM OF 21 074 UNITS, AS FOLLOWS:"
2460 PRINT\FOR I = 1 TO 12\PRINT USING 2470,I,(I^.3 * 10000)
2470.         HF - ##      POWER CONSUMED - ##### UNITS
2480 NEXT I\PRINT
2490 PRINT "HYPERSPACE NAVIGATION TENDS TO BE SOMEWHAT ERRATIC, RESULTING"
2500 PRINT "IN NAVIGATION ERRORS; THE HIGHER THE HF  THE GREATER THE"
2510 PRINT "POTENTIAL ERROR."
2520 RETURN
2530 END
```

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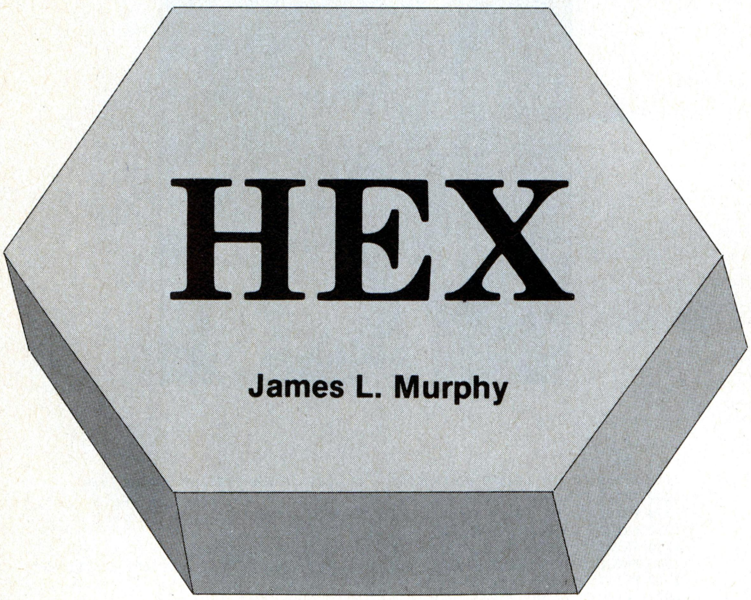
Another new game from Creative Computing....



HEX

James L. Murphy

Two players take turns placing X's and O's within hexagonal cells, only one symbol per cell. Two cells are connected if they share an edge. The winner is the first player to occupy a connected group of cells, one of which is on a side of the board and another is on the opposite side of the board. In this version of the game, it does not matter which pair of opposite sides is connected. In some versions of this game, each player is assigned ahead of time the pair of opposite sides that must be connected to win. By removing line 360, the human player will always go first so you can use the program to print boards on which two human players can then play HEX without the computer.

Line	*Comments*
100-360	Initialization; instructions; parameters in lines 140 and 150 determine the computer's strategy
365-650	Print the board of hexagons
655-790	Computer checks legality of human move, updates connected groups
820,830	Random opening move for computer
840-900	Save a copy of board and matrices containing the connected groups for the computer and for the human player
930-1400	Compute a value S for each empty cell. 1 to NxN
980	Checks cells adjacent to the cell under consideration
990	Points for adjacent opponent cells
1000	Points for adjacent machine cell
1010	Points for adjacent blank cell
1030	Points if this move would join human groups previously separated
1040	Points if this move would join machine groups previously separated
1050	Points if this move would give human a win
1060	Points if this move would give machine a win
1070-1130	Check cells two cells away with two ways to join them on a later move
1140-1240	As above for a different angle
1320-1350	RESTORE the record of connected groups before this move
1360-1400	Check for maximum value on moves considered thus far
1410-1480	Execute computer move and check for win
1510-1780	Check to see if move P is adjacent to any cells occupied by human marker. If so, add this cell to that group and any other groups connected in this way. H1 is the number of groups, P(I) the number of cells in group I, h(I,J) the cells of group I for J=1 to P(I)
1790-1940	Subroutine to detect a win
1950-2210	Same as subroutine 1510 except for the machine rather than human player. M1=number of groups, C(I)=number of cells in group I, M(I)=cells in group I for J=1 to C(I)
2230-2410	Find which cells are adjacent to the cells in row I column J, store these in A(I)
2420-2630	In each direction find the longest connected group, and which cells are at each end.

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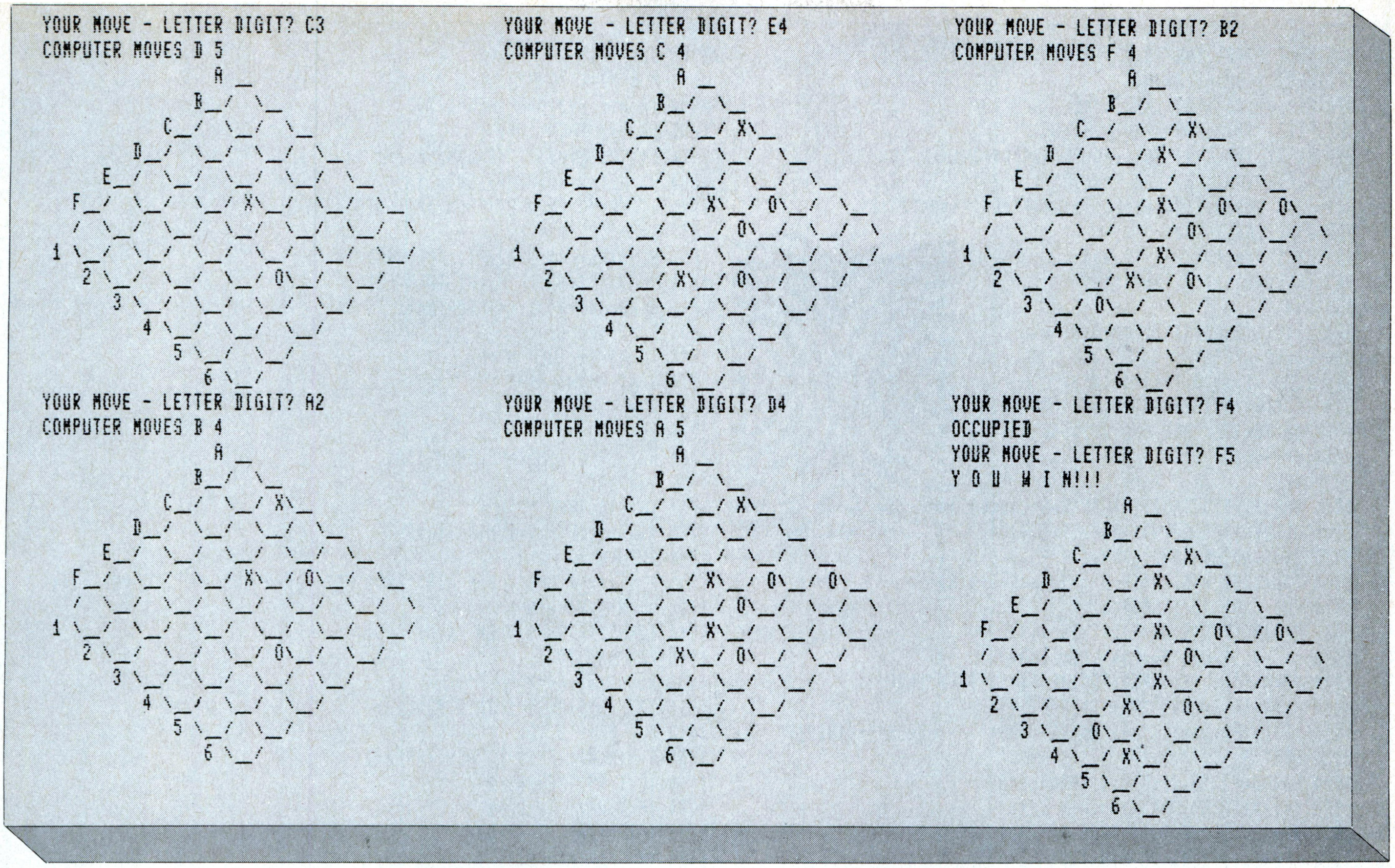
Sample Run

```
THE GAME OF HEX.
INSTRUCTIONS? YES
ON A BOARD OF HEXAGONS YOU ARE X AND
THE COMPUTER IS 0. THE OBJECT OF THE
GAME IS TO OCCUPY A CONNECTED STRING
OF HEXAGONS FROM ANY ONE SIDE TO THE
OPPOSITE SIDE. MOVES ARE INPUT BY
SPECIFYING A LETTER FOLLOWED BY A
NUMBER WITH NOTHING IN BETWEEN; E.G.,
A4 OR C2.


WHAT SIZE BOARD 3 - 11? 6
                 A __
               B__/  \__
            C__/  \__/  \__
         D__/  \__/  \__/  \__
      E__/  \__/  \__/  \__/  \__
   F__/  \__/  \__/  \__/  \__/  \__
   /  \__/  \__/  \__/  \__/  \__/  \
 1 \__/  \__/  \__/  \__/  \__/  \__/
    2 \__/  \__/  \__/  \__/  \__/
       3 \__/  \__/  \__/  \__/
          4 \__/  \__/  \__/
             5 \__/  \__/
                6 \__/
```



```
YOUR MOVE - LETTER DIGIT? C3
COMPUTER MOVES D 5
                 A __
               B__/  \__
            C__/  \__/  \__
         D__/  \__/  \__/  \__
      E__/  \__/  \__/  \__/  \__
   F__/  \__/  \__/ X\__/  \__/  \__
   /  \__/  \__/  \__/  \__/  \__/  \
 1 \__/  \__/  \__/  \__/  \__/  \__/
    2 \__/  \__/  \__/ O\__/  \__/
       3 \__/  \__/  \__/  \__/
          4 \__/  \__/  \__/
             5 \__/  \__/
                6 \__/
YOUR MOVE - LETTER DIGIT? A2
COMPUTER MOVES B 4
                 A __
               B__/  \__
            C__/  \__/ X\__
         D__/  \__/  \__/  \__
      E__/  \__/  \__/  \__/  \__
   F__/  \__/  \__/ X\__/ O\__/  \__
   /  \__/  \__/  \__/  \__/  \__/  \
 1 \__/  \__/  \__/  \__/  \__/  \__/
    2 \__/  \__/  \__/ O\__/  \__/
       3 \__/  \__/  \__/  \__/
          4 \__/  \__/  \__/
             5 \__/  \__/
                6 \__/
```

```
YOUR MOVE - LETTER DIGIT? E4
COMPUTER MOVES C 4
                 A __
               B__/  \__
            C__/  \__/ X\__
         D__/  \__/  \__/  \__
      E__/  \__/  \__/  \__/  \__
   F__/  \__/  \__/ X\__/ O\__/  \__
   /  \__/  \__/  \__/ O\__/  \__/  \
 1 \__/  \__/  \__/  \__/  \__/  \__/
    2 \__/  \__/ X\__/ O\__/  \__/
       3 \__/  \__/  \__/  \__/
          4 \__/  \__/  \__/
             5 \__/  \__/
                6 \__/
YOUR MOVE - LETTER DIGIT? D4
COMPUTER MOVES A 5
                 A __
               B__/  \__
            C__/  \__/ X\__
         D__/  \__/  \__/  \__
      E__/  \__/  \__/  \__/  \__
   F__/  \__/  \__/ X\__/ O\__/ O\__
   /  \__/  \__/  \__/ O\__/  \__/  \
 1 \__/  \__/  \__/ X\__/  \__/  \__/
    2 \__/  \__/ X\__/ O\__/  \__/
       3 \__/  \__/  \__/  \__/
          4 \__/  \__/  \__/
             5 \__/  \__/
                6 \__/
```

```
YOUR MOVE - LETTER DIGIT? B2
COMPUTER MOVES F 4
                 A __
               B__/  \__
            C__/  \__/ X\__
         D__/  \__/ X\__/  \__
      E__/  \__/  \__/  \__/  \__
   F__/  \__/  \__/ X\__/ O\__/ O\__
   /  \__/  \__/  \__/ O\__/  \__/  \
 1 \__/  \__/  \__/ X\__/  \__/  \__/
    2 \__/  \__/ X\__/ O\__/  \__/
       3 \__/ O\__/  \__/  \__/
          4 \__/  \__/  \__/
             5 \__/  \__/
                6 \__/
YOUR MOVE - LETTER DIGIT? F4
OCCUPIED
YOUR MOVE - LETTER DIGIT? F5
Y O U  W I N!!!
                 A __
               B__/  \__
            C__/  \__/ X\__
         D__/  \__/ X\__/  \__
      E__/  \__/  \__/  \__/  \__
   F__/  \__/  \__/ X\__/ O\__/ O\__
   /  \__/  \__/  \__/ O\__/  \__/  \
 1 \__/  \__/  \__/ X\__/  \__/  \__/
    2 \__/  \__/ X\__/ O\__/  \__/
       3 \__/ O\__/  \__/  \__/
          4 \__/ X\__/  \__/
             5 \__/  \__/
                6 \__/
```

Program Listing

```
100 DIM M(20,40),H(20,40),C(20),P(20)
110 DIM M1(20,40),H1(20,40),C1(20),P1(20)
120 DIM B$(121),A(6),V(14)
130 MAT READ V
140 DATA 2,3,1,50000,200000,200,1000
150 DATA 300,100,500,200,500,400,50
160 RANDOM:&'THE GAME OF HEX.'
170 INPUT'INSTRUCTIONS';A$
180 IF A$='NO' THEN 290
190 IF A$='YES' THEN 210
200 PRINT'YES OR NO DO YOU WANT ';:GOTO 170
210 &'ON A BOARD OF HEXAGONS YOU ARE X AND'
220 &'THE COMPUTER IS O. THE OBJECT OF THE'
230 &'GAME IS TO OCCUPY A CONNECTED STRING'
240 &'OF HEXAGONS FROM ANY ONE SIDE TO THE'
250 &'OPPOSITE SIDE. MOVES ARE INPUT BY'
260 &'SPECIFYING A LETTER FOLLOWED BY A'
270 &'NUMBER WITH NOTHING IN BETWEEN, E.G.,'
280 &'A4 OR C2.':&:&
290 MAT C=ZER:MAT P=ZER
300 W,M1,H1=0
310 B$(P)=" " FOR P=1 TO 121
320 H$="\_/"
330 L$="ABCDEFGHIJKLMN"
340 INPUT"WHAT SIZE BOARD 3 - 11";N
350 N=INT(N):IF N<3 OR N>11 THEN 340
360 IF RND(1)<.5 THEN 800
365 REM **********PRINT BOARD****************************
370 X=3*N-3
380 PRINT TAB(X+2);"A _"
390 B$="_/":E$="\_"
400 FOR K=1 TO N
410 X=3*(N-K)
420 I=K+1:IF K=N THEN E$="\":PRINT TAB(X+3);"/";:GOTO 440
430 PRINT TAB(X);MID(L$,K+1,1);B$;
440 FOR T=K TO 1 STEP -1
450 J=K+1-T:I=I-1
460 P=N*(I-1)+J
470 PRINT" ";B$(P);
480 IF T=1 THEN 500
490 PRINT H$;
```

```
460 P=N*(I-1)+J
470 PRINT" ";B$(P);
480 IF T=1 THEN 500
490 PRINT H$;
```

```
500 NEXT T:PRINT E$
510 NEXT K
520 FOR K=1 TO N
530 K1=3:IF K>9 THEN K1=4
540 PRINT TAB(3*K-K1);K;
550 FOR T=1 TO N+1-K
560 PRINT H$;
570 I=N+1-T:J=T+K
580 P=N*(I-1) + J
590 IF T= N+1-K THEN 610
600 PRINT " ";B$(P);
610 NEXT T
620 PRINT
630 NEXT K
640 IF W>0 THEN 2650
650 IF Z=N*N THEN 2640
655 REM ***** TAKE IN USER'S MOVE CHECK IT AND EXECUTE IT ***
660 INPUT "YOUR MOVE - LETTER DIGIT";A$
670 A$=CVT$$(A$,-1)
680 J=VAL(RIGHT(A$,2))
690 A$=LEFT(A$,1)
700 I=INSTR(1,L$,A$)
710 IF I<1 OR J<1 OR I>N OR J>N THEN 660
720 P=N*(I-1) +J
730 IF B$(P)<>" " THEN PRINT "OCCUPIED":GOTO 660
740 B$(P)="X"
750 Z9=0
760 GOSUB 1510
770 GOSUB 1790
780 Z=Z+1
790 IF W > 0 THEN PRINT "Y O U  W I N!!!":GOTO 370
795 REM ***** COMPUTER CALCULATES ITS MOVE *****************
800 P2=N*N-Z:IF P2=0 THEN 370
810 IF Z>0 THEN 840
820 I=INT((N-2)*RND(1)+2):J=INT((N-2)*RND(1)+2)
830 P=N*(I-1)+J:GOTO 1420
840 M8,H8=0:FOR I=1 TO H1:IF P(I)>H8 THEN H8=P(I)
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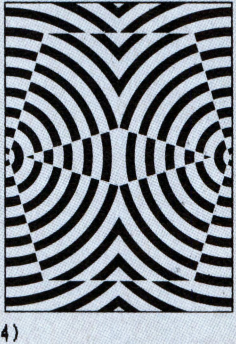
```
850 NEXT I:FOR I=1 TO M1:IF C(I)>M8 THEN M8=C(I)
860 NEXT I:H9=H1:M9=M1
870 C1(I)=C(I) FOR I=1 TO M1
880 P1(I)=P(I) FOR I=1 TO H1
890 M1(I,J)=M(I,J) FOR I=1 TO M1 FOR J=1 TO M8
900 H1(I,J)=H(I,J) FOR I=1 TO H1 FOR J=1 TO H8
910 Z9=0:GOSUB 2420:B1=G1:B2=G2:B3=G3:B4=G4:B5=D4
920 Z9=1:GOSUB 2420
930 S9=1:V=0:FOR P=1 TO N*N
940 IF B$(P)<>' ' THEN 1400
950 S=0
960 I=INT((P-1)/N)+1:J=P-N*(I-1)
970 GOSUB 2220
980 FOR K=1 TO A:T$=B$(A(K))
990 IF T$='X' THEN S=S+V(1):GOTO 1020
1000 IF T$='O' THEN S=S+V(2):GOTO 1020
1010 S=S+V(3)
1020 NEXT K
1030 GOSUB 1550:IF D>1 THEN S=S+D*V(6)
1040 GOSUB 1980:IF D>1 THEN S=S+D*V(7)
1050 Z9=0:GOSUB 1790:IF W>0 THEN S=S+V(4)
1060 Z9=1:GOSUB 1790:IF W>0 THEN S=S+V(5)
1070 FOR D=-1 TO 1 STEP 2
1080 K=I+D:IF K<1 OR K>N THEN 1130
1090 L=J-D:IF L<1 OR L>N THEN 1130
1100 P2=N*(K-1)+L:T$=B$(P2):IF T$=' 'THEN 1130
1110 V1=8:IF T$='X' THEN V1=9
1120 IF B$(P2+D)=' ' AND B$(P2-D*N)=' ' THEN S=S+V(V1)
1130 NEXT D
1140 FOR D=-2 TO 2:IF D=0 THEN 1240
1150 K=I+D:IF K<1 OR K>N THEN 1240
1160 D1=SGN(D):IF D=D1 THEN D1=2*D1
1170 L=J+D1:IF L<1 OR L>N THEN 1240
1180 P2=N*(K-1)+L:T$=B$(P2):IF T$=' ' THEN 1240
1190 V1=10:IF T$='X' THEN V1=11
1200 IF ABS(D)=1 THEN 1230
1210 IF B$(P+D1*N)=' ' AND B$(P+D1*N+D1)=' ' THEN S=S+V(V1)
1220 GOTO 1240
1230 IF B$(P+D)=' ' AND B$(P+N*D+D)=' ' THEN S=S+V(V1)
1240 NEXT D
1250 G5=I:G6=J:IF B5=1 THEN G5=J:G6=I
1260 IF ABS(B2-G6)<=B1-G5 THEN S=S+V(12)*(B3-B1)^2
1270 IF ABS(B4-G6)<=G5-B3 THEN S=S+V(12)*(B3-B1)^2
1280 G5=I:G6=J:IF D4=1 THEN G5=J:G6=I
1290 IF ABS(G2-G6)<=G1-G5 THEN S=S+V(13)*(G3-G1)^2
1300 IF ABS(G4-G6)<=G5-G3 THEN S=S+V(13)*(G3-G1)^2
1310 H1=H9:M1=M9
1320 C(I)=C1(I) FOR I= 1 TO M1
1330 P(I)=P1(I) FOR I= 1 TO H1
1340 M(I,J)=M1(I,J) FOR I= 1 TO M1 FOR J=1 TO M8
1350 H(I,J)=H1(I,J) FOR I= 1 TO H1 FOR J=1 TO H8
1360 IF S>V THEN S9=1:GOTO 1390
1370 IF S<V THEN 1400
1380 S9=S9+1:IF RND(1)>1/S9 THEN 1400
1390 V=S:P5=P
1400 NEXT P
1410 P=P5
1420 B$(P)='O'
1430 Z=Z+1
1440 I=INT((P-1)/N)+1:J=P-N*(I-1)
1450 PRINT"COMPUTER MOVES ";MID(L$,I,1);J
1460 GOSUB 1950
1470 Z9=1
1480 GOSUB 1790
1490 IF W>0 THEN PRINT"C O M P U T E R   W I N S.":GOTO 370
1500 GO TO 370
1505 REM ***** UPDATE CONNECTED GROUPS FOR PERSON **********
1510 P=N*(I-1) + J
1520 IF H1>0 THEN 1540
1530 H1=1:H(1,1)=P:P(1)=1:RETURN
1540 GOSUB 2220
1550 D=0:FOR A1=1 TO A
1560 C=A(A1)
1570 H2=1
```



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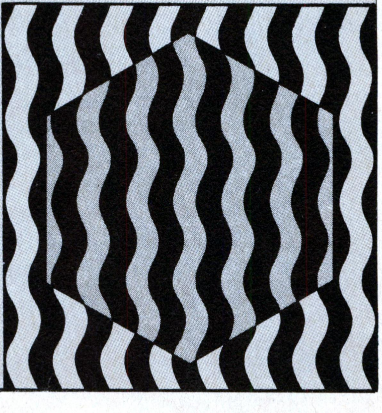
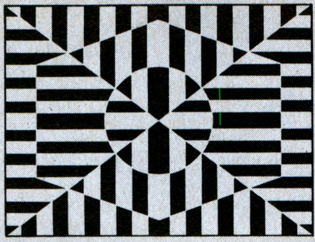
1580 A3=P(H2)
1590 FOR A2=1 TO A3
1600 IF H(H2,A2)<>C THEN 1730
1610 IF D>0 THEN 1640
1620 D=1:P(H2)=A3+1:H(H2,A3+1)=P
1630 H3=H2:H2=H1:A2=A3:GOTO 1730
1640 IF H2=H3 THEN A2=A3:H2=H1:GOTO 1730
1650 D=D+1:P1=P(H3)
1660 H(H3,P1+A4)=H(H2,A4) FOR A4=1 TO A3
1670 P(H3)=P1+A3:IF H2=H1 THEN 1710
1680 H(H2,A4)=H(H1,A4) FOR A4=1 TO P(H1)
1690 P(H2)=P(H1)
1700 IF H3=H1 THEN H3=H2
1710 P(H1)=0:H1=H1-1
1720 A2=A3:H2=H1
1730 NEXT A2
1740 H2=H2+1:IF H2<=H1 THEN 1580
1750 NEXT A1
1760 IF D>0 THEN 1780
1770 H1=H1+1:P(H1)=1:H(H1,1)=P
1780 RETURN
1785 REM ***** CHECK FOR WIN  Z9=0 FOR HUMAN OR 1 FOR COMPUTER ***
1790 W5=N+1:W6=N*N-N
1800 T1=H1:IF Z9=1 THEN T1=M1
1810 FOR A=1 TO T1
1820 W1,W2,W3,W4=0
1830 T2=P(A):IF Z9=1 THEN T2=C(A)
1840 FOR B=1 TO T2
1850 T=H(A,B):IF Z9=1 THEN T=M(A,B)
1860 IF T<W5 THEN W1=1
1870 IF T>W6 THEN W2=1
1880 T=T-N*INT((T-1)/N)
1890 IF T=1 THEN W3=1
1900 IF T=N THEN W4=1
1910 NEXT B:W=W1*W2+W3*W4
1920 IF W=0 THEN 1940
1930 A=T1
1940 NEXT A:RETURN
1945 REM ***** UPDATE CONNECTED GROUPS FOR COMPUTER *********
1950 IF M1>0 THEN 1970
1960 M1=1:M(1,1)=P:C(1)=P:C(1)=1:RETURN
1970 GOSUB 2220
1980 D=0:FOR A1=1 TO A
1990 C=A(A1)
2000 M2=1
2010 A3=C(M2)
2020 FOR A2=1 TO A3
2030 IF M(M2,A2)<> C THEN 2160
2040 IF D>0 THEN 2070
2050 D=1:C(M2)=A3+1:M(M2,A3+1)=P
2060 M3=M2:M2=M1:A2=A3:GO TO 2160
2070 IF M2=M3 THEN A2=A3:M2=M1:GOTO 2160
2080 D=D+1:P1=C(M3)
2090 M(M3,P1+A4)=M(M2,A4) FOR A4=1 TO A3
2100 C(M3)=P1+A3
2110 IF M2=M1 THEN 2150
2120 M(M2,A4)=M(M1,A4) FOR A4=1 TO C(M1)
2130 C(M2)=C(M1)
2140 IF M3=M1 THEN M3=M2
2150 C(M1)=0: M1=M1-1
2160 NEXT A2
2170 M2=M2+1:IF M2<=M1 THEN 2010
2180 NEXT A1
2190 IFD>0 THEN 2210
2200 M1=M1+1:C(M1)=1:M(M1,1)=P
2210 RETURN
2220 REM FIND ADJACENT CELLS
2230 A=0:MAT A = ZER
2240 I1=I-1
2250 IF I1<1 THEN 2290
2260 J1=J-1:IF J1<1 THEN 2280
2270 GOSUB 2400
2280 J1=J:GOSUB 2400
2290 I1=I:J1=J-1
```





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2300 IF J1<1 THEN 2320
2310 GOSUB 2400
2320 J1=J+1:IF J1>N THEN 2340
2330 GOSUB 2400
2340 I1=I+1:J1=J
2350 IF I1>N THEN 2390
2360 GOSUB 2400
2370 J1=J+1:IF J1>N THEN 2390
2380 GOSUB 2400
2390 RETURN
2400 A=A+1:P1=N*(I1-1)+J1
2410 A(A)=P1:RETURN
2415 REM ***** FIND LONGEST CONNECTED GROUP AND IN WHICH DIRECTION ***
2420 D3=0:H2=H1:IF Z9=1 THEN H2=M1
2430 FOR I=1 TO H2:G1,G3=N+1:G2,G4=0
2440 C1=P(I):IF Z9=1 THEN C1=C(I)
2450 FOR J=1 TO C1
2460 P=H(I,J):IF Z9=1 THEN P=M(I,J)
2470 I1 = INT((P-1)/N)+1:J1=P-N*(I1-1)
2480 IF I1<G1 THEN G1=I1:G5=P
2490 IF I1>G2 THEN G2=I1:G6=P
2500 IF J1<G3 THEN G3=J1:G7=P
2510 IF J1>G4 THEN G4=J1:G8=P
2520 NEXT J
2530 D=G2-G1:D1=G4-G3
2540 D2=0:IF D<D1 THEN D=D1:G5=G7:G6=G8:D2=1
2550 IF D<D3 THEN 2570
2560 D3=D:D4=D2:D5=G5:D6=G6
2570 NEXT I
2580 G1=INT((D5-1)/N)+1:G2=D5-N*(G1-1)
2590 G3=INT((D6-1)/N)+1:G4=D6-N*(G3-1)
2600 IF D4=0 THEN RETURN
2610 T=G1:G1=G2:G2=T
2620 T=G3:G3=G4:G4=T
2630 RETURN
2640 PRINT'T I E  G A M E.'
2650 END
```

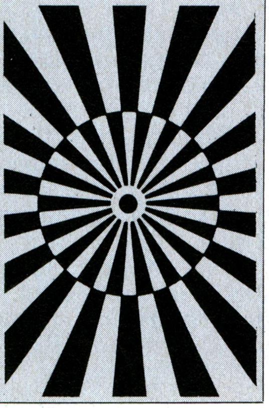

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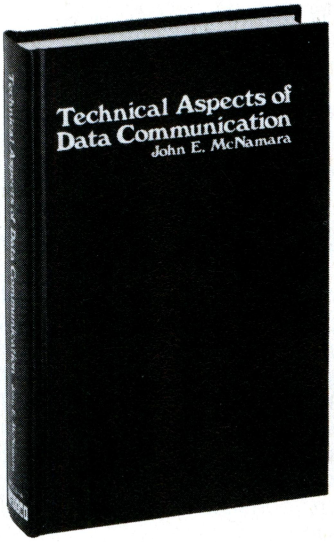

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The Systems Approach:
How to evaluate, design, and implement a software application

by John R. Lees

Have you ever thought up an application, you know, "Gee, I wish I had a program to dindle my framistan," and started to write it, maybe get a little code running, but bog down somewhere and never carry through? If so, it's quite possible that you were suffering from a lack of systems approach. Perhaps the single most important step in completing a software project, and the one most often neglected by the big and little programmer alike, the systems approach consists of thinking things through in advance.

Sure, that sounds simple and obvious ("I thought things through, I want a program to dindle my framistan"). However, it *isn't* simple and obvious. Large "real world" programming projects spend a significant portion of their time and budgets in coming up with a system design. Of course for your own personal project you're not going to be worried about things like how many programmers you can effectively use during each phase of the project, and whether you need a project librarian, but there are a number of techniques that have been developed that will be of benefit to you.

I. Iterative procedure of refinement and repetition. The final result is, hopefully, a project which will work.

II. Hardest thing to do is to get a good overall picture of what you want before you have it.

A. Think it through; try to imagine using your completed application. Try to make a list of everything you want to be able to do and how you want to do it.

B. If others are going to use the application, get their input. Good idea to talk it over with someone else, anyway.

III. If the project is large, break it up into parts which can be coded and tested separately.

IV. Be realistic in evaluating storage, time, interface requirements. Remember you have a small system and may have to make sacrifices in your design to get it implemented.

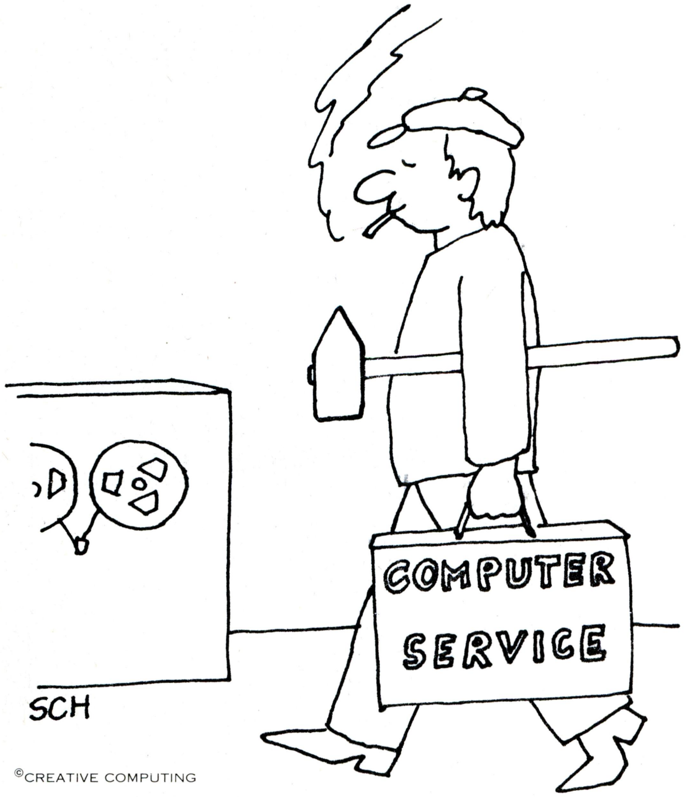
IV. Plan files, storage, subroutines, etc.

V. Once you get a design, STICK WITH IT! Do not give in to the temptation to change things in midstream. That is the single most prevalent reason for projects never being completed.*

VI. Figure out how to test it before using it. ■

---

*A recent Rand Corp. study (read thorough and costly) indicates that the ratio of the actual time to complete a well-planned project compared to the estimated time is 3 to 1.



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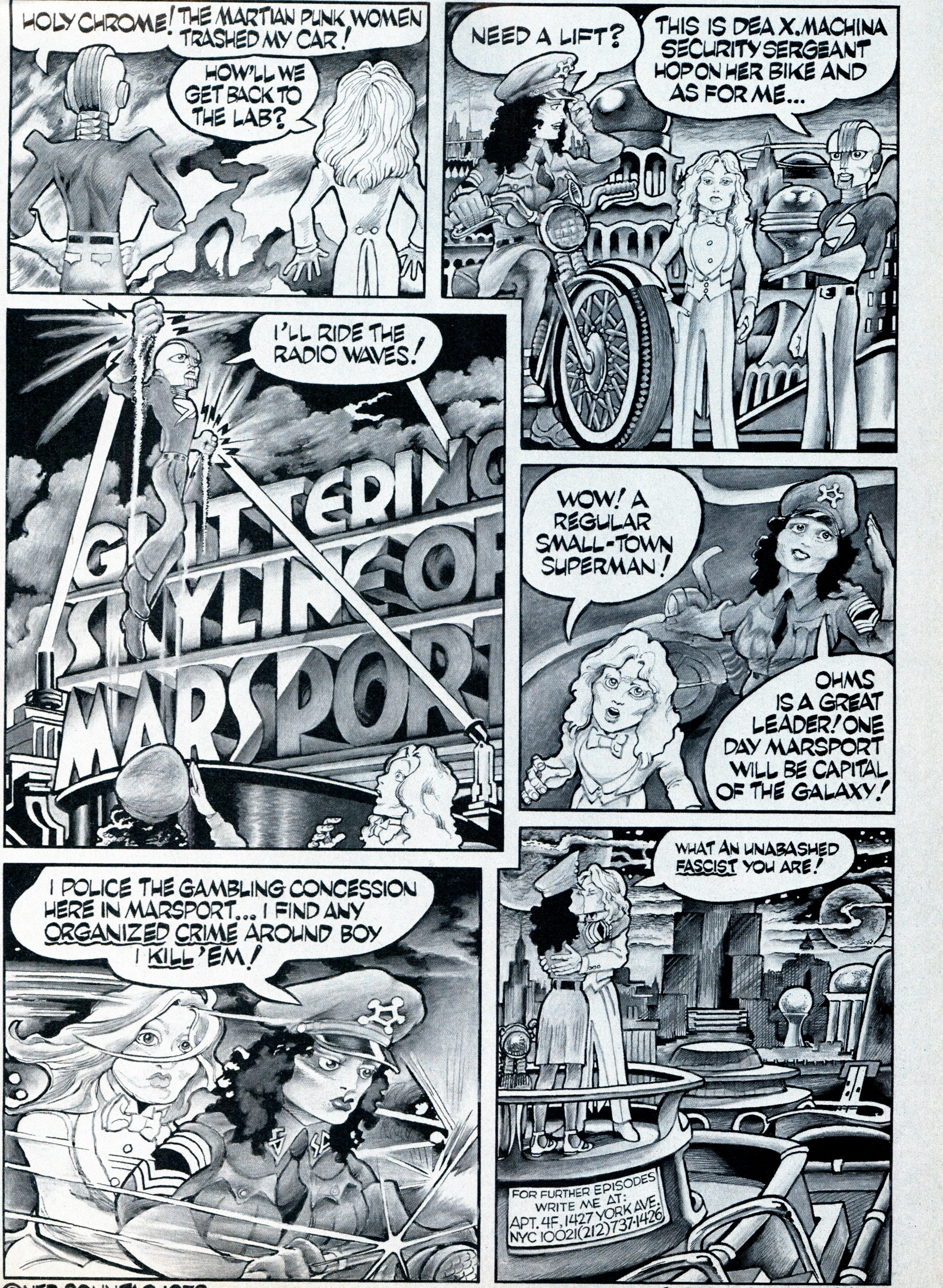
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END OF TRANSMISSION

40 Programming Ideas

by J. Cletheroe, Sandhurst School, England

Many of these ideas are not original, but they are gathered together here for convenience. They are presented in random order. [Condensed from a longer list which appeared in *Computer Education.*]

1. Evaluate 'pi'.
2. Provide an information retrieval system (for example information about characters in a book).
3. Provide an 'array arithmetic' package. Numbers are held with each digit in a separate cell of an array, and these numbers can be added, subtracted, etc.

4. Round numbers (to so many decimal places or significant figures).
5. Compute the intersection and union of two numerical sets.
6. Test a number for being prime; print a list of prime numbers.
7. Find the HCF and/or LCM of two numbers.
8. Convert numbers from any base to base ten/base ten to any base/any base to any base.
9. Find the first few Perfect Numbers.
10. Print the Fibonacci Sequence.
11. Print the Fibonacci Sequence in a Modular Arithmetic – you get a set of 'rings'.
12. Work out square roots without using the square root function.
13. Simulate the action of the Absolute Value function.
14. Divide without using the / facility.
15. Print multiplication and division tables; repeat in a modular arithmetic.
16. Sort a two element/three element/n element set of numbers into order.
17. Print Pascal's Triangle.
18. Print Random Sentences, for example in the format (article) (noun) (verb) (article) (noun).
19. Solve problems like CROSS + ROADS = DANGER.
20. Convert from Arabic to Roman Numerals and vice-versa.
21. Matrix inversion.
22. Produce abstract (random) 'art'.
23. Game playing by heuristic (learning) methods.
24. Print squares and other shapes out of asterisks.
25. Print large letters out of asterisks (for posters etc.).
26. Simulate the action of the random number generator.
27. Print powers of 2 until the numbers have more than 100 digits.
28. Work out the best straight line through a set of points on a graph.
29. Output numbers in words (e.g. 512 gives FIVE HUNDRED AND TWELVE).
30. Text Analysis (frequency of letters, etc.).
31. Play the game of guessing a letter (is it a vowel?, has it any straight lines?, etc.).
32. Produce a plot of prime numbers (* for a prime, space for a non-prime). The user should select the number of elements per line of the plot. Are there any patterns?
33. Produce a table of n and the number of primes below n (call this m). Does m tend towards a function of n as n becomes large?
34. Simulate the growth of a colony of Amoebae (doubling in number every unit time, but allow for deaths due to the food supply running out and pollution building up). Can you achieve a stable state?
35. Produce a list of Primes using the 'Sieve of Eratosthenes' – strike out multiples of 2, find the next non-zero entry (which is the next prime), strike out multiples of this number, and so on.
36. Statistical work to test the randomness of the random number generator. For example, produce a table of the frequencies of ascending and descending runs of length n.

37. Print numbers with leading zeroes, to give

```
   1
  15
   3
2357
```

rather than

```
1
15
3
2357
```

(which is what normally happens).

38. Scan a set of numbers and print the highest and the lowest.
39. Read in three numbers which are the lengths of the three sides of a triangle. Print (as appropriate) "ACUTE", "RIGHT ANGLED", "OBTUSE" or "NO TRIANGLE FORMED".
40. Store lists of variable length. ■

ROM

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Dr. Pascal, I presume.

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PASCAL

by Jim Merritt

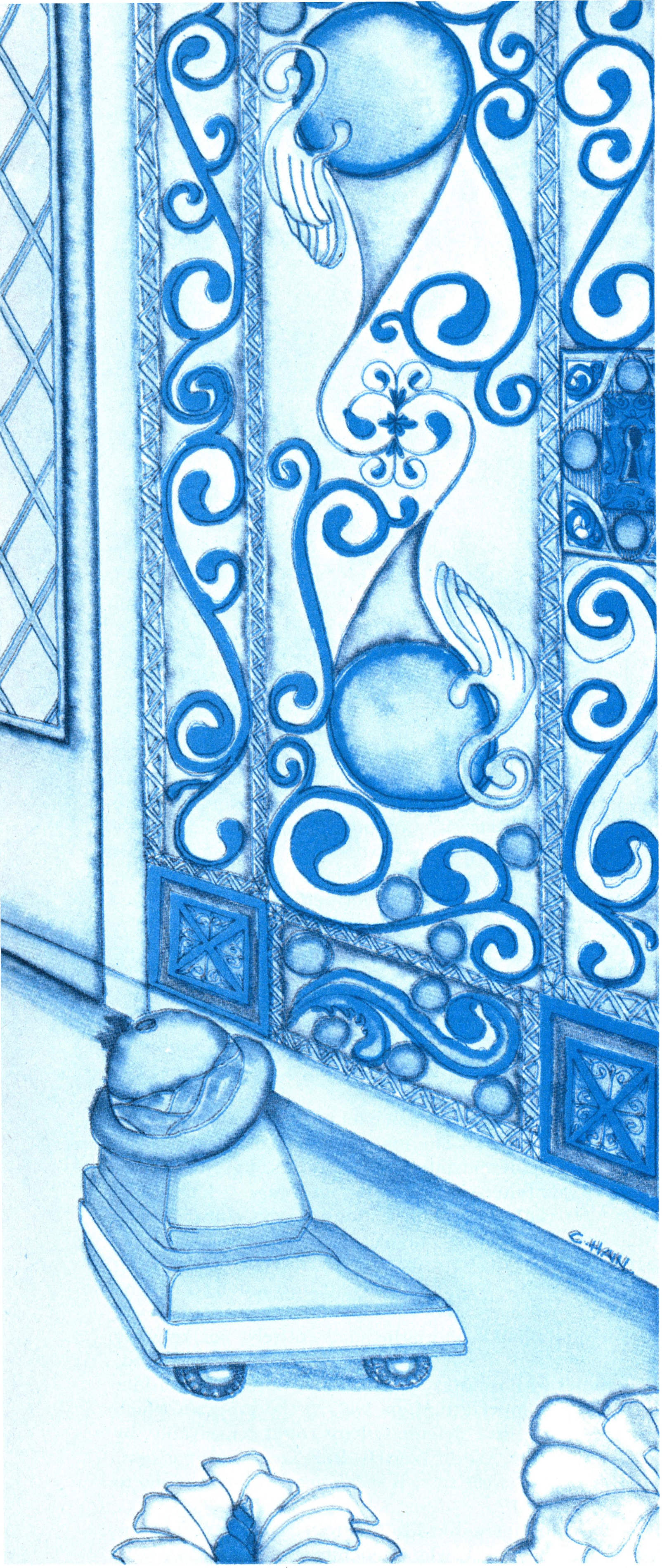
From BEGINning to END

One of the biggest problems you face in dealing with computers is that it's rather hard to communicate with a machine. Computers must be told exactly what they are to do and how to do it before they can be put to work at useful tasks such as balancing your checkbook, regulating heat and light in your home, preparing financial reports for your office, and so forth. Unfortunately, computers do not speak English and probably won't be able to do so for many years, if ever. It is possible, though, to submit a carefully designed and well-planned set of instructions to your computer which then allows it to trounce you at chess, help you with homework, play your latest musical composition, water your grass, or whatever else you have in mind.

The set of instructions which tells a computer what to do is called a *program.* The instructions themselves must be written using the vocabulary and the rules of grammar of a special computer-programming *language* which your computer can understand. As long as you converse with your computer in this language, it will be able to make sense of what you want to do and can go about obeying your wishes. If you fail to form your instructions correctly, according to the rules of the language, the computer will throw up its hands and either halt entirely, not knowing how to proceed, or continue in a way you hadn't planned, sometimes with disastrous results. (For instance, consider that a small imperfection, or *bug,* in the program which controls our missile-defense systems could conceivably, by accident, trigger World War III. Bugs are serious business, and the moral of the story is speak gently and *carefully* to your machine!)

The reason it's so hard to talk to a machine is that the computer languages, which machines understand so well, bear little resemblance to any natural language that

Illustrated by Cindy Hain



humans speak (such as English, French, or German). At this moment in the history of computers, each machine can understand only its own specific *machine code.* Instructions in machine code are merely numbers. Several numbers may be strung together to form a *machine-code program.* As an example, the following short program is written in machine code for the 8080, which is commonly found in inexpensive home systems.

```
62 65 211 2 118
```

Assuming that a teletype or video terminal is hooked up to "port 2" (which is the second of the 8080's 256 "windows to the outside world"), the above program will send a capital *A* to the printer or screen and then halt. Because you are probably more familiar with decimal (base 10) style numbers, I presented the program in this way, hoping it might be easier to read. However, machine-code instructions for the 8080 are usually written in *hexadecimal* notation. "Hex" is a number system based on 16 separate digits: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, and F. For instance, decimal-10 is represented as hex-A, decimal-16 as hex-10, and decimal-256 (or 16^2) as hex-100. The hex version of the capital *A* program is:

```
3E 41 D3 02 76
```

But even this cryptic form is not good enough for the machine itself! Computers work with numbers in *binary* (base 2) form, using only 1s and 0s. The way this program would look inside the machine (if you could read electric impulses) is still more confusing:

```
00111110 01000001 11010011 00000010 01110110
```

None of this is particularly inspiring or helpful to the poor person, like you or me, who just wants to get an *A* on the screen. Certainly, the businessman trying to get out a sales report or a student who needs to edit a term paper will not put up with such nonsense. Even professional programmers find machine code awkward and boring to use. The fact is humans can't easily deal with "meaningless" numbers. So, to get around this, a special program was written which could translate catchy little names for the instructions into their numeric equivalents. Each numbered instruction would, for the programmer's convenience, be replaced by an abbreviated word reminiscent of the function of the particular instruction, called a *mnemonic.* This way, the programmer could write:

```
MVI A,'A'   (move an 'A' into the waiting area)
OUT 02      (send what's in the waiting area OUT to
            port 2, the TV screen)
HLT         (halt)
```

This translator program (called an *assembler*) would then convert the mnemonics back into number form, which is the only form the computer itself can use and understand. The use of assemblers makes it possible for programmers to use a "language," that is, an *assembly language,* in which the instructions are (somewhat) meaningful, but still provide the computer with *its* instructions in proper numeric form.

Machine code and assembly language have never been very popular among programmers. They are especially hard to teach and learn, partially because humans tend to think in terms of the problem at hand, while machine and assembly languages allow expression of a problem or its method of solution only on a very rudimentary basis, closely tied to the computer's own limited design and, in any case, far removed from the terminology of the problem. In the case of our capital *A* program, what the programmer really wants to do, perhaps, is tell the computer

WRITE('A')

and forget about unrelated things like "waiting areas," "output ports," and so on.

The word *WRITE* means something to a person. You might just as easily instruct your secretary or student to "write a capital A." Such a command neatly expresses what you want to do. Most people in programming feel that computers should be made to understand such instructions.

Computers must be told exactly what to do and how to do it before they can be put to work at useful tasks.

More importantly, every different computer has its own unique machine code (and hence a unique assembly code, too), so a person who wants to instruct computers at the machine level must, in effect, learn a new language for each separate computer he or she encounters. The program written for the 8080 computer will not work in the 6800 machine. In order to transfer a machine-code program from one computer to another, the programmer must painstakingly rewrite the entire thing in the other's machine code or assembly language. Many people feel that this is a waste of valuable programmer time and effort and have, throughout the years, demanded a "standard language" which many, if not all, computers would understand. For good technical reasons, it is not feasible to enforce a standard machine code. The search for a standard language must proceed in another direction.

In the ever-continuing push to help machines better understand instructions which a person feels comfortable in giving and to find a standard programming language, *high-level languages* (HLLs) were born. Machine and assembly code are called *low-level languages,* because the programmer must formulate and attack the problem on the computer's terms. High-level languages, on the other hand, allow you to express the problem or task in ways closer to those you might use to instruct another person.

A well-planned set of instructions allows your computer to trounce you at chess or water your grass.

But no computer can understand high-level instructions by itself. Remember, computers *really* understand only machine code. However, we can write programs which translate the HLL instructions into machine code for us, just as the assembler translated assembly language. These high-level translator programs have a different name than assembler, because their tasks are more involved than simply changing mnemonics to numbers. HLL-to-machine-code translators are known as *compilers.* The compiler accepts your HLL program and then writes that same program in the machine code your computer understands.

By writing the same translator program in several machine languages, the same HLL can be used with different computers, even if their respective machine languages are totally dissimilar. Thus, a HLL can act as a standard language among people who possess the appropriate translators.

Several HLLs are available for the person owning a small computer. These include FORTRAN, BASIC, and, the most recent, PASCAL. FORTRAN and BASIC are just two computer languages which were developed years ago and, at the time, represented great strides ahead in helping people talk to their computers. In both, an attempt was made to use instructions similar to English words, so that computer programs could be more easily written, understood, and corrected. However, as the first true HLL, FORTRAN, while far easier to use than machine or assembler code, has always been a rather difficult language with which to write programs. The inventors of FORTRAN did a fine job for their day, but could not possibly have had enough experience in designing HLLs for easy use by people.

A few years later, computer scientists at Dartmouth College, taking the knowledge gained from experiences of people working with FORTRAN, created what they felt was an easily learned, easily used language adequate for beginners and suitable as a vehicle to teach elementary programming concepts: BASIC (Beginner's All-purpose Symbolic Instruction Code). At the time BASIC was first formulated, there were no small computers such as are found in businesses and homes today, so the language nestled in the large multi-user computers of colleges and universities, gaining a reputation as a pleasant, though limited, "teaching language."

Once today's microcomputers began proliferating, a vast need arose for a HLL which could be quickly learned and applied in the creation of games and other home and business programs. BASIC seemed to satisfy the requirements and soon became the de facto standard HLL for the new small-computer industry. Unfortunately, as an admittedly limited beginner's tool and sixteen years old to boot, BASIC was not well suited for the complex, involved tasks the microcomputer users began to demand of it. For various reasons, it is hard to write a large program in BASIC without some confusion. To circumvent this difficulty, microcomputer manufacturers developed improvements and extensions of BASIC which helped computerists get their jobs done. But these improvements only added to the confusion, as disagreements between manufacturers over what were the best and most useful extensions led to several

different and largely incompatible versions of BASIC, most of which survive into the present day. At this point, BASIC is not the convenient standard it might have been—there is too much difficulty encountered in moving a program written for one version of the language to a machine which uses another version; the same type of problem encountered when using machine code! Also, as enthusiasts added extra features to the several versions of the language, they conveniently forgot that, as a beginner's language, BASIC was intended for small, instructive programs given out as programming assignments or examples in computer classes. It was not intended as a tool for the development of large-scale home and business programs and has more than once vexed programmers who dared to use it for such purposes.

The built-in limitations of the language and the relative inexperience of its designers, when compared with that of the language specialist of today, have marked BASIC in the same way as FORTRAN: a nice, serviceable, but outmoded antique in today's world of computers and programming languages.

As we have recognized the inappropriateness of BASIC, FORTRAN, and other early languages to today's computing needs, the search has started again for a new standard HLL: one which is easy to learn, easy to apply to both small and large programs, and one which allows the programmer to work very much in the abstract—that is, to write computer instructions which closely resemble human instructions and which are tailored to the specific problem at hand, rather than to a certain computer's needs, construction, and limited capabilities. In the sea of languages available today, one has emerged which seems to satisfy all these needs and more, providing an elegant, easy way for you to talk sense to your computer. That language is PASCAL.

As a relatively new language, PASCAL benefits from decades of experience in designing, testing, and improving computer languages. It's creator, Professor Niklaus Wirth of Zurich, drew from previous languages successful and useful features and instructions to emulate, as well as design failures to avoid. At all times during the development of PASCAL, the intention was to produce a tool for programmers which would *help,* not hinder, the writing of clear, concise, correct computer programs and would especially facilitate the task of writing large, complex programs, since large projects are understandably harder and cause more problems for the programmer than small ones.

PASCAL is similar to the currently popular BASIC in that it, too, was developed as a teaching language—as a means through which to impart the principles of good programming to computer-science students—and has since been employed by many colleges and universities around the world for exactly that purpose. PASCAL is easily learned—many of these institutions are successfully teaching PASCAL in introductory programming courses to students who often have never dealt with computers before. Previously, BASIC and FORTRAN were the staples of introductory courses, and, while this practice persists, the academic popularity of PASCAL is very much on the rise. Such a situation promises to increase the PASCAL "literacy" rate to the point where it rivals those of

BASIC, FORTRAN, and COBOL (a language commonly used in business programming).

The PASCAL Users' Group, headquartered (for the Western Hemisphere) at the University of Minnesota in Minneapolis, now boasts over 1600 members in thirty-two countries (including Indonesia and Malaysia), according to PUG head Andy Mickel. The membership includes academics, professional programmers, and small-computer enthusiasts, among others. *PASCAL NEWS,* published quarterly by PUG, is their prime means of communication, in which a lucid description of the state of PASCAL development and use worldwide is presented, as well as an on-going forum where PUG members discuss, debate, and propose *orderly* improvements and extension of the language to better fit the needs of the computing community.

A bug in the program which controls our missile-defense systems could trigger World War III.

There is considerable work being done to make PASCAL available to as many computer users as possible, and much *applications software* (programs written to perform specific tasks such as playing chess or computing mortgage amortization) is being written in PASCAL against the time when the language achieves the status of a standard HLL. We are rapidly approaching this point, as industry as well as education is beginning to embrace the language. In the September 1977 issue of *PASCAL NEWS,* it was reported that Texas Instruments and Harris Data Communications are two large concerns who now use PASCAL either extensively or exclusively when writing company programs. According to Robert Ranson of ADP Technology in St. Louis, the U. S. Department of Defense is considering PASCAL, or a language so similar to it that translation between the two is trivial, as the new standard language for armed-forces programming (replacing FORTRAN and COBOL—no small achievement!). Finally, while PASCAL has been available to large-computer users for several years, recent developments at the University of California at San Diego and elsewhere have, at long last, brought the language to the small computerist as well—specifically, to those who work with the 8080 or Z-80 machines.

All this seems to point to an imminent future when PASCAL will be a popular, standard medium used by both professional programmers and home computerists to talk to their machines. Because the language may finally be used with microcomputers, I feel the time is ripe to begin a thorough, tutorial discussion of it. If you bear with me, you, too, can learn to program computers easily in PASCAL. While we will write several smaller programs during the discussion, we will spend most of our time using PASCAL to attack a "real-world" problem.

The fact is humans can't easily deal with meaningless numbers.

You, as a home-computer enthusiast, have heard about the many ways a computer may be used to automate various mechanical processes around the house such as heating, lighting, smoke and intruder detection, and so on. You decide to start small, by "computerizing" a door so that it may be unlocked only after the appropriate password is punched into a small calculator keypad that you will install just outside the door. You have the necessary mechanical and electronic equipment—it is *physically* possible for your computer to control the lock. However, you must first write a program which tells the computer *how* to accomplish this task. In PASCAL, the required program might possibly look like this:

```
begin
lockthedoor;
repeat
    if somebodywantsin
      then begin
          askforkey;
          if keyisgood
            then begin
                unlockthedoor;
                waitforpersontoenter;
                lockthedoor;
                end
            else write('bad key—try again');
          end;
until autolockisturnedoff;
end.
```

Using BASIC, the closest counterpart to the PASCAL instructions is as follows:

```
10 GOSUB 6000
20 IF FNI < >1 THEN 100
30 GOSUB 7000
40 IF FNK< > 1 THEN 90
50 GOSUB 6500
60 GOSUB 8000
70 GOSUB 6000
80 GOTO 100
90 PRINT "BAD KEY — TRY AGAIN"
100 IF FNL< >1 THEN 20
110 END
```

Clearly, the PASCAL program is closer to plain English than BASIC, yet, even though PASCAL instructions may be easier to understand, you can see right away that programming in PASCAL is not the same as using ordinary language. For instance, what happened to the spaces in "lockthedoor" and the other instructions? Why couldn't we have written "lock the door"? What purpose do the parentheses serve after we say "write"? Why do we use so many begins, ends, and semicolons? Let's take a moment to answer these questions and so learn a few of the rules of PASCAL programming.

Figure 1
PASCAL Statements

A single instruction by itself

Example:
```
write('This is a single instruction')
```

A single instruction between the words begin and end

Example:
```
begin write('This is statement type 2') end
```

A series of instructions between begin and end, and each, except the last, followed by a semicolon

Example:
```
begin write('Even though there are three writes here ');
begin write('this is still just ') end;
write('one statement—a COMPOUND statement.')
end
```

When you program in a high-level language, the instructions you give to the computer are individually called *statements.* (For myself, I like to use the term *instruction,* but since the official *PASCAL User Manual* prefers statement, I'll try to use it more often. As far as I'm concerned, the two are synonymous, so don't be confused!) An instruction or statement tells the computer to do something: water the lawn, do the tax form, compute the square root of 2, lock a door, and so forth. In PASCAL, there are three major forms of statements. (See figure 1.)

In the compound statement shown in figure 1, notice that we also put a begin..end type statement *within* the first begin..end pair. This is acceptable in PASCAL. Indeed, the inner begin..end could have surrounded another compound statement, instead of just the single "write" we put there. When you put a statement within a statement, you are said to be *nesting* statements. In figure 1, the inner statement is nested within the total compound statement.

> *In the world of personal computing, it is important that your program be readable.*

Notice that even our door-lock program is nothing more than a large compound statement! In fact, since *all* PASCAL programs must be surrounded by begin and end, all are large compound statements.

Exercise: See if you can find all the instances of nesting within the door-lock program.

One last note on nesting may help before we move on. In PASCAL, it is generally considered good practice to *indent* a few spaces each time you nest statements. (Use the door-lock program as an example.) Indenting is used to improve program readability—to help someone else understand what you've written. In the real world of personal computing, with so many people writing and swapping programs, it is important that your program be understandable. Indenting helps, so use it. From now on, I will follow this practice for *every* example, so you can more easily identify nested statements.

Now, knowing what a compound statement is, you can see why the program is "littered" with begins and ends, and also why we use semicolons so profusely—the "semis" separate instructions within compound statements, and begin and end must surround every compound statement!

The compound statement is useful because it is treated as a *single unit* by the computer. When your machine sees a begin..end pair, it knows to do everything inside *first,* before doing anything on the outside. *This is the same reason we use parentheses in arithmetic and algebra!* Just as there are times when you want the result of an entire expression to be taken as a *whole* in math, you will often find it necessary for your computer to perform certain jobs first, before going on to others. *The pair* begin..end *is to* PASCAL *statements as the parentheses are to math expressions.*

Q: Why not use parentheses instead?
A: As words, begin and end are just easier to read and follow—that's all.

It would be nice if a computer language included sufficient vocabulary so that there would be commands for all the practical things we'd like our computers to handle. "Turn on (and off) the lights" would be one such command. "Cook breakfast" would be another. In our case, we want the computer to "lock the door," "ask for key," and so on.

Unfortunately, with so many different things to do—an *infinite* number of possibilities when you think about it—how could one computer language ever include built-in commands for them all? And another thing, would everyone be satisfied with the command *names* if they *were* available? For example, we've said "lock the door," but somebody else might prefer to say "bolt it" or "secure the door." Each person is most comfortable using his or her own personal vocabulary when giving directions or solving a problem. How could one vocabulary in a programming language suit or please everyone?

Language designers (especially those who designed PASCAL) feel that the solution to the problems of "universal capability" and "universal vocabulary" is to endow a language with a powerful, but *limited,* set of rudimentary instructions from which you may create and name your own custom programs, procedures, and functions to do any computable task. Once built from the basic instructions, these commands become "part" of the language and may even be used to define other custom commands! (This business of creating new custom commands from combining old ones gives you considerable power—we will discuss this in more detail in a future article.)

> *PASCAL provides an elegant, easy way for you to talk sense to your computer.*

We do the same thing when we teach people. If you have a door lock which is rather difficult to use, you might show a child exactly how to operate it, then say, "That's the procedure for locking the door." From that time on, assuming the child is a fast learner (and obedient), you would expect that the request to "lock the door, please" would be followed unhesitatingly and unerringly, according to your earlier instructions.

A computer is indeed a fast learner and never forgets what it has "learned" (unless explicitly told to do so, or an accident destroys its memory). However, as with a child, you must painstakingly and very patiently give the computer its initial instructions, which will then be followed, without fault or delay, forever after, as long as you command the machine using the name you have given to the procedure.

While the command to "write" is built-in to the PASCAL language, our intruction to "lockthedoor" is not. In order for the compiler to understand what we want when we use the command, we must first write a procedure which tells the computer *how* to lock the door. We name the procedure "lockthedoor," and from then on in our program, whenever we use that word, the computer will know to refer back to our earlier definition of the command and carry out the task.

When we say "lockthedoor" then, we are not telling our machine to do something which it naturally "knows" how to do. Instead, we are referring by *name* to the set of basic PASCAL instructions we wrote before, which tells exactly how to do it in language the compiler can "understand."

In PASCAL, names are called *identifiers.* An identifier is easy to make up, being simply defined as a sequence of characters such that the first is a letter, and any following characters are either letters or digits. (The capital and lower-case letters and the digits 0-9 are collectively known as the *alphanumeric* characters.) This definition of identifiers rules out using spaces or other punctuation within names.

As it stands now, a space signals the end of an identifier. If spaces *were* allowed in names, they would effectively be ignored by the compiler. For instance, suppose you had two procedures, named "abc" and "def." If the compiler ignored spaces, how could it distinguish between "abc def" and "abcdef"? In the first case, you would have made an error, since "abc" and "def" are, being two custom commands, separate instructions (statements), and they cannot be placed together without a semicolon between them. In the second case, "abcdef" is one custom instruction and, therefore, a single statement. Which case does the compiler choose? In order to make the right choice (and so "second-guess" you), it would have to have considerable intelligence of its own. This could possibly introduce enough additional complexity and size in the compiler that it would be too massive to operate in small systems and would be fit only for the multi-million-dollar "dinosaur" machines. In order to get a compiler for a very powerful language which, nevertheless, can fit within a small computer's limited facilities, we, as intelligent human beings, must agree to put up with having to write "askforkey," instead of "ask for key." This way, the spaces we *do* use in our programs act to definitely separate indentifiers from one another and also separate indentifiers from *keywords.*

Keywords have meanings and uses vital to the PASCAL language itself and so cannot be redefined and used by the programmer as identifiers. To emphasize their special sig-

Figure 2
Roughing It with PASCAL

AREA NAME	AREA CONTENTS	EXAMPLES
D/D Area	Program Heading	program anyname (input,output) ;
	(Other objects declared here)	
Program Area	the program	begin
		end.

nificance, keywords are customarily underlined in PASCAL programs. (By looking at our door-lock program, then, you can see that the words begin, end, repeat, if, else, and several others are keywords.) If you try to use else as an identifier, for example, the compiler would tell you that you have made an error in your program and refuse to translate it to machine code. Just as a compiler could not tell the difference between "abc def" and "abcdef," if it ignored spaces, it also would be confused by such indentifiers as "fifo" and "lifo" (which might show up in a business program), because they contain the keyword if and could also be interpreted as "f if o" and "l if o," respectively. The PASCAL rule that a space ends a word resolves that ambiguity.

Samples of legal PASCAL identifiers:

corn	(even though it contains the keyword or)
CoRn	(which is a different identifier than "corn")
a123bc	
thisidentifierisverylongbutstillok	

Samples of illegal identifiers:

12abc	(identifiers may not begin with digits)
ab:cd	(the colon isn't allowed—only alphanumerics)
record	(record is a keyword)
not ok	(spaces aren't allowed—also, since not is a keyword, the compiler would assume that "ok" is the identifier in this case)

When the PASCAL compiler sees an identifier like "lockthedoor," "askforkey," or even "write" in a program, it looks to see if the name has been assigned to any previously defined object (such as a procedure or function) in your program. If so, the object is substituted, and if not, the compiler says you've made a mistake, since the word is "undefined" or "undeclared." Except in very rare circumstances which we won't be discussing, all procedures must be written, or *declared,* before they are used in your program. In general, *anything you invent and name in order to help you with your program must be declared prior to use.* As we'll see in future articles, PASCAL allows you to "invent" a lot of tools and will treat such fabrications exactly as if they were part of the language itself!

> *When we say "lockthedoor," we are not telling our machine to do something which it naturally "knows" how to do.*

One of the tools which you *don't* have to invent for yourself is the "write" procedure. ("Write," as the name of a procedure, is hence an identifier, not a keyword.) Its purpose is to allow you to send messages or data to your terminal. It is used a lot, obviously because people want to see the results of their computations. Most programs aren't of much use unless they can send understandable results to their users (in other words, unless they can output information). It stands to reason that most everyone would need such a procedure in *every* program. If you had to create the "write" procedure anew for each new program, you would probably tire of PASCAL in a very short time. Anticipating this, the designers of the language wrote it for you. "Write" is said to be *predeclared.* It exists as a procedure exactly as if you had declared it yourself. In order to use "write" in a program, you simply insert its name at any point in the program where you want to see results. However, the lone instruction "write" will not tell the computer to send anything to your terminal. What's to send? You must follow the "write" with a list of the messages or data you wish to see. This list should be in parentheses, and each individual item must be separated from the next by a comma. For instance, the instruction

```
write('Item 1', 'Item 2', 'Item 3')
```

will send the three separate messages to the terminal, one after another. We can also send numbers to your screen or printer using "write":

```
write(1.27, 23, 100.987)
```

In fact, there are a variety of quantities which may be printed on your terminal through the "write" procedure. We'll look into the detailed function of "write" in another article.

Even though "write" and a number of other objects are given to us "free," we must still invent the procedures which are not otherwise available, such as "lockthedoor," and "waitforpersontoenter." In a PASCAL program, objects you define are declared (written) in the area immediately above the first begin in the program itself. I call this the *D/D area* (for "declarations and definitions," naturally). The program, of course, comprises the *program area.*

The first line in a PASCAL program (and so the first thing in the D/D area) declares the name of the program itself and is called the *program heading.* Here is ours for the door-lock program:

```
program lockit(input, output);
```

The program heading consists of the keyword program followed by an identifier which then becomes the program name. In the parenthetical list (which is optional in some systems), we have informed PASCAL that we want our program to be capable of both input and output. (In those systems which require the parenthetical list, you must explicitly state whether you want input only, output only, or both.) The program heading is terminated by a semicolon. (In the program area, as we have seen, the "semi" is used to separate statements. Similarly, it is used in the D/D area to separate definitions and declarations.)

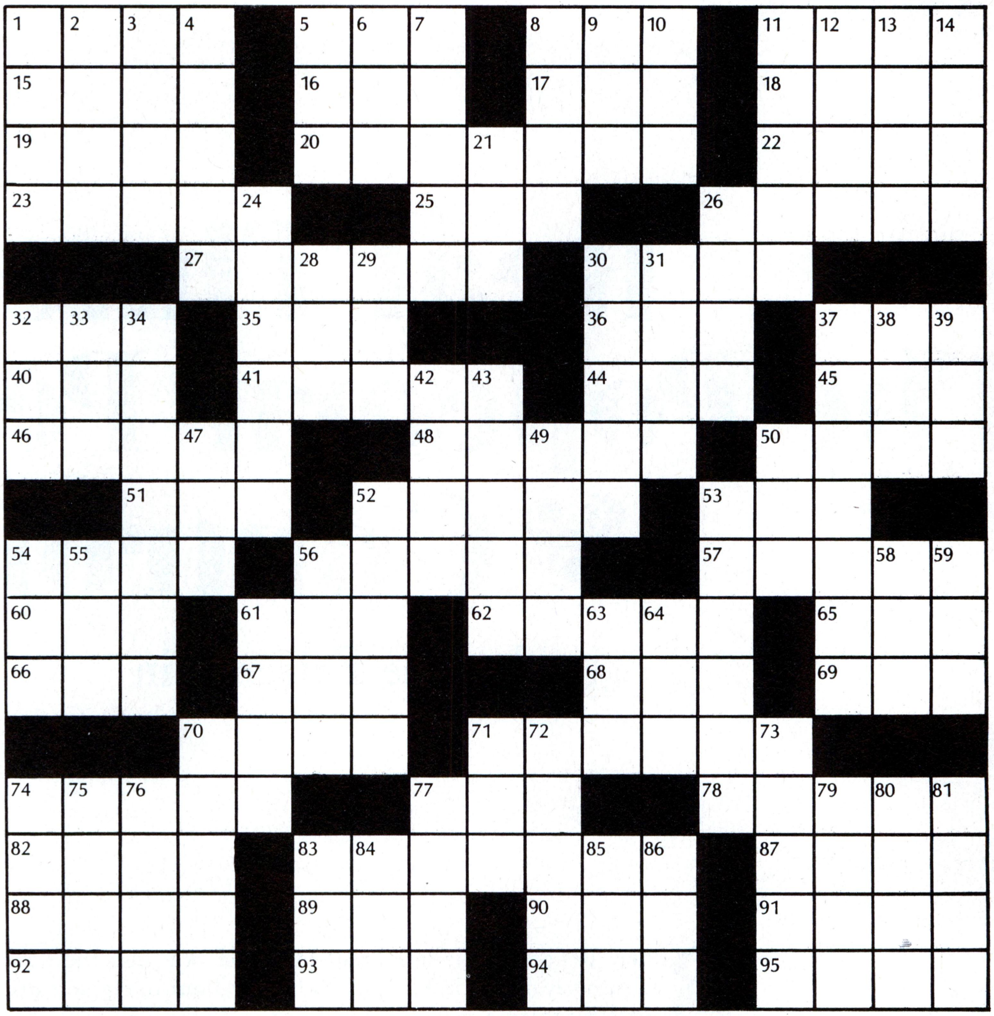
Now that we have named our program and have begun to use both the D/D and the program areas, we can rough out a diagram of the basic elements of a PASCAL program (see figure 2). As we learn more, taking a closer look at keywords and custom commands used, we can flesh out a diagram like this until it becomes a reasonable guide to the correct formation of a PASCAL program. ▼

PROMpuzzle

by Daniel Alber

ACROSS

1. Machine-oriented languages (abbr.)
5. Popular computer device
8. Law enforcers (abbr.)
11. Delay time
15. My friend in Lyon
16. Automatic data acquisitions (abbr.)
17. Aristotle's nickname
18. ____ANDING
19. Mend socks
20. Semiconductor impurities
22. A Great Lake
23. Destroy data
25. Letter of the alphabet
26. Snow vehicles
27. Puts in data
30. Unit of storage
32. Terminal control system (abbr.)
35. Commercials
36. A Gabor
37. Voice answer back (abbr.)
40. Landed
41. Open circuit
44. Morning moisture
45. Epoch
46. Xmas tune
48. Prongs
50. Search for data
51. Crude metal
52. Type of semiconductor junction
53. ____rep
54. Ali ____
56. Withdraws computer power
57. A computer language
60. ____ de France
61. Ms. Farrow
62. Cattle
65. ____ Grande
66. Poetic contraction
67. Island (abbr.)
68. Australian bird
69. Put a storage device in a prescribed state
70. Biblical boats
71. ____ finger action
74. ____ mode
77. Lend an ____
78. Output-input signal ratios
82. Mother ____
83. Action of an automatically controlled system
87. Ontario or George
88. ____ microprogrammer processors
89. Logical operator
90. Educator's group (abbr.)
91. Space
92. Fellow
93. ____ and no
94. Lid
95. Back talk



The solution to this PROMpuzzle will appear in next month's *ROM*.

DOWN

1. Created
2. The tent maker
3. Italian coins
4. Punched-hole paper reading
5. Papa
6. Marriage vow (2 wds.)
7. ____ tape
8. Dailey and Cupid
9. Skill
10. Family member
11. Live
12. Ireland
13. Dry
14. Letter of the alphabet (pl.)
21. Beast of burden
24. ____ input pin
26. Cole ____
28. Transmit data register (abbr.)
29. Compass reading
30. Surrendered
31. Nights before
32. Kindness, for short
33. Government agency (abbr.)
34. Waveform enlargements
37. One-dimension arrays
38. Constellation
39. Forbid
42. Particle
43. Some relays
47. ____ pro nobis
49. Bird's abode
50. Dear ____
52. Some systems
53. ____ out
54. Binary digit, for short
55. Muhammed ____
56. ____ drive system
58. Fib
59. Fate
61. Muck and ____
63. Poetic contraction
64. Electromagnetic interference (abbr.)
70. Avoid
71. Took a chair
72. Give a paper readout
73. Festive occasions
74. Metallic core
75. Misplace
76. Arabian gulf
77. Some instruments
79. Scarlett's manse
80. Squeezes out
81. Oceans
83. Fodder
84. One (Fr.)
85. New (prefix)
86. ____ digits

Real Time, The Popcorn Perplex, & Control

by Lee Felsenstein

Robert Benchley, the late great humorist, was also the possessor of a fabulously messy desk. One day he set about to clean it up, together with his secretary. He came to one paper and absently handed it to the secretary, muttering, "Bring this to my attention."

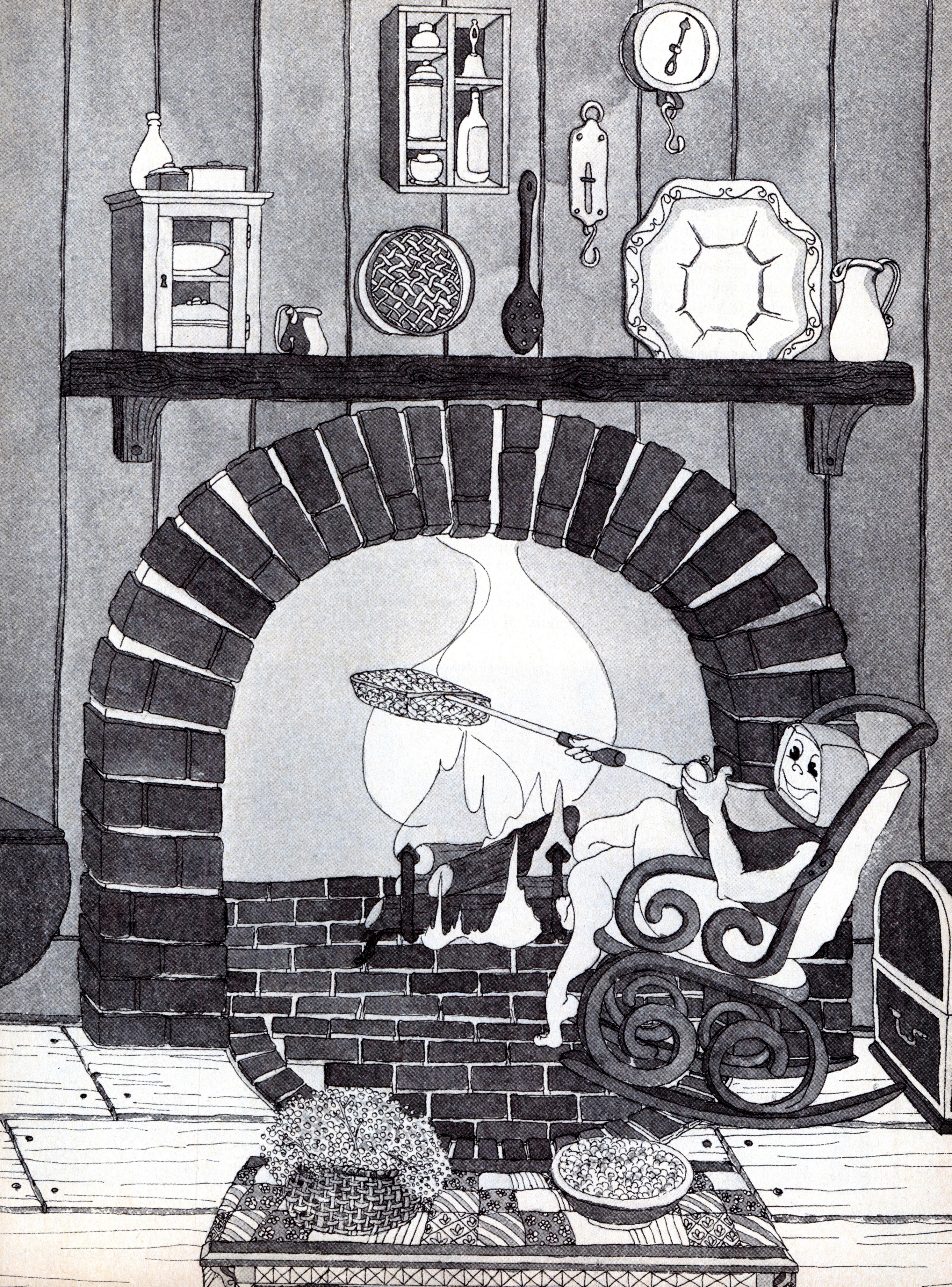
The secretary responded, "Now, sir?"

That being the precomputer era, the anecdote makes the point that the secretary knew more about being an executive than did Benchley. If we were to replace the secretary with a computer, the script would be the same, but the point of the anecdote would be that to a computer, the time is *always* "right now." Unless, of course, the computer is given a clock and instructions on how to use it.

A previous article (*ROM* March-April 1978) discussed an absolute-time clock and showed how to build one for a microcomputer. Making use of a digital clock circuit, it could show the time of day to the nearest second. For lots of processors, however, computers don't care what the time of day is, but they must be able to keep track of much shorter time intervals accurately. These processes require a clock more like a stopwatch, or one that sounds a bell every so often. Timers like these used in computers are called *real-time clocks.* (We shall not go into the reality or unreality of time here.)

A good example of a real-time application would be the making of popcorn. As we all know, popcorn is done when the sound of its pops slows down to about one per second. If you wait until there are no more pops, the popped corn will probably be burned. Now if, say, you want to make some popcorn while you are in the middle of a chess game or some other occupation requiring your undivided attention, it would be nice to have your computer take control of the decision as to when the corn is done.

Illustrated by Cindy Hain



Let us say that you had rigged a microphone to listen to the popping corn and attached some electronics to convert the sound of each pop into a momentary closure of a pair of switch contacts. By connecting this contact closure to one pin of the parallel input connector of your computer, you would be able to notify the computer of each and every pop. So far, so good.

Now comes the problem. How do you notify the computer of the time interval occurring between the pops? Forget about asking your computer to use its judgment; it hasn't got any. Obviously you have to provide something like an electronic stopwatch, along with complete instructions for its use. The circuit we describe here is a repetitive-interval timer over which the computer can exercise various forms of control:

The computer can select one of five time scales, ranging from 1/100,000 second (or 10 microseconds) down to 1/10 second.

The computer can issue a command to reset the timers to zero and start them counting.

The computer can check to see if the time interval has been completed and can reset the flag signal without interrupting the count.

With this gimcrack added on, the great popcorn perplex becomes trivial.

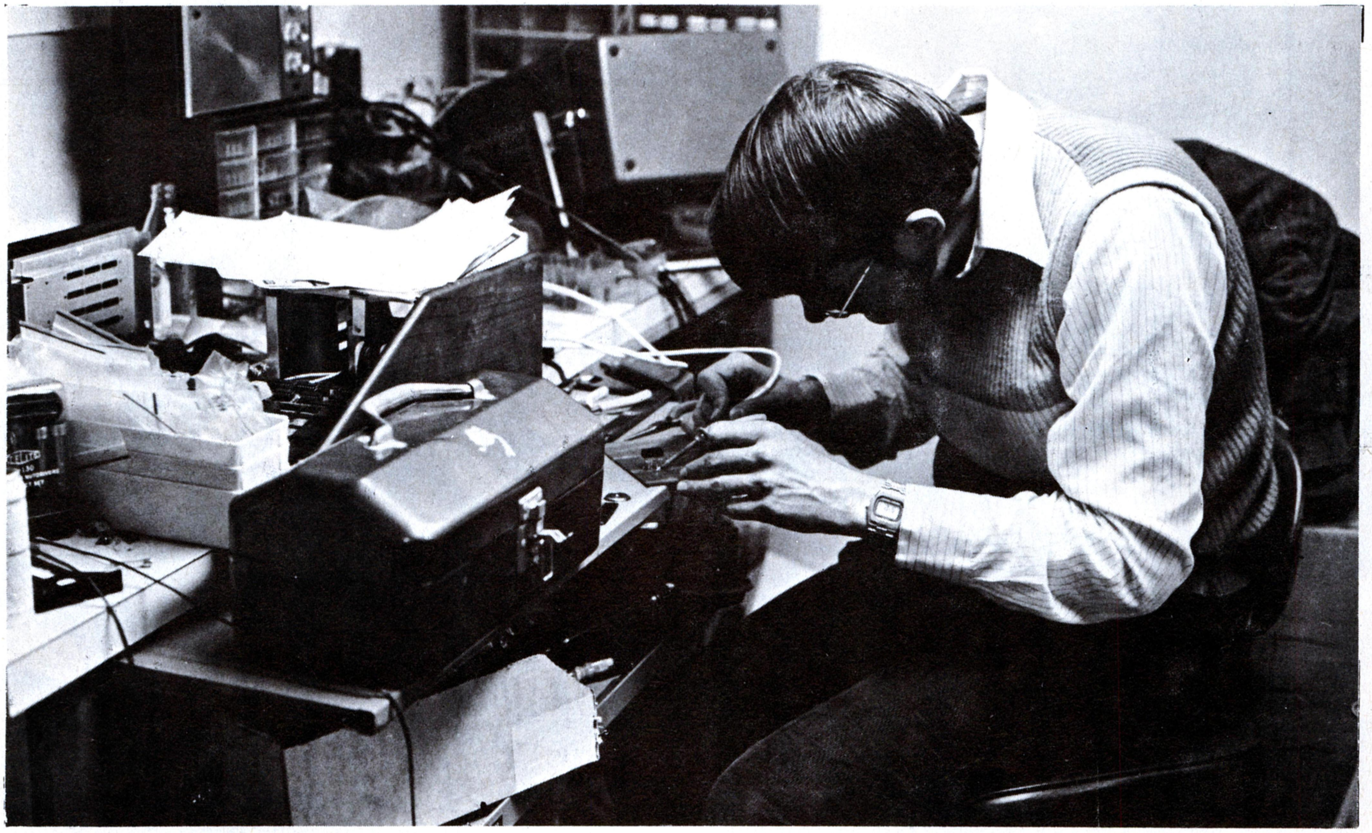
With this gimcrack added on, the great popcorn perplex becomes trivial. The computer sets the timer for 1/10 second, then checks whenever it can to see if the timer has gone off. When it has, the computer resets the flag and increments a number tucked away in a register. It then resumes checking the clock, along with checking the input from the microphone.

If the number in the register gets to ten without a pop detected, then one silent second has gone by. The computer should then reset the number in the register to zero and record the fact of the silent second somewhere in its memory. If ten seconds go by with a total of less than ten pops (which can, of course, occur in random short bursts), then the average of one pop per second has been achieved, and it's time to turn down the heat and notify the master.

No problem is that simple, of course. The computer has to decide that the corn has been popping for a while before it starts looking for the one-per-second rate. Otherwise it would ring the gong before the corn had started up (dumb machine!). But the real-time clock makes this decision just as easy for the computer as the silent second. If, say, more than ten pops are recorded in one second, then the computer can reasonably conclude that the corn has really started popping.

You will probably want to know how the real-time clock circuit knows how much time has passed. The time base upon which it is built is an oscillator stabilized by a crystal which forces the oscillator to run at 18.0000 megahertz (million cycles per second). The crystal is ground and tested during manufac-

Note: The 18-megahertz crystal may be obtained from James Electronics, 1021 Howard Avenue, San Carlos, CA 94070 (415-592-8097).



The designer in his lair designing

ture so as to fall within .005 percent of the specified frequency. This kind of quartz crystal is widely used in electronics for this purpose, and it is what gives the advertising boys the right to say "quartz" when talking about an electronic wristwatch.

Electronic counter integrated circuits are used to divide the oscillator frequency down to usable rates. These counter circuits are fairly simple devices which in effect play a game of hopscotch to the beat of the signal fed to them. They hop through a certain number of squares and then hop back to the beginning in one big jump. If you consider this "hop back" the output of the circuit, then the counters divide the input beat by a fixed number to produce the output. The outputs can in turn be fed as inputs to another counter, creating a "chain" of dividers which can rapidly knock a high input frequency down to a low one—with lots of convenient in-between steps.

We used the 18-megahertz crystal because it was the first multiple of 60 hertz cheaply (about $5) and readily available. A divide-by-three counter immediately reduces the frequency to 6 megahertz. This frequency is then fed to a chain of five 7490 counters, each of which divides by ten. Thus they produce 600-kilohertz, 60-kilohertz, 6-kilohertz, 600-hertz, and 60-hertz frequencies. (Sixty hertz was chosen as the output so that it could be fed to run an absolute-time clock at some time in the future.) A selector circuit (74151) chooses one of these frequencies (on command from the computer) and passes it on to a divide-by-six counter. This step, then, can produce a 100-kilohertz, 10-kilohertz, 1-kilohertz, 100-hertz, or 10-hertz signals. Another way of looking at these numbers is to say that the circuit produces an "event" every ten microseconds, hundred microseconds, millisecond, ten milliseconds, or hundred milliseconds, as selected by the computer.

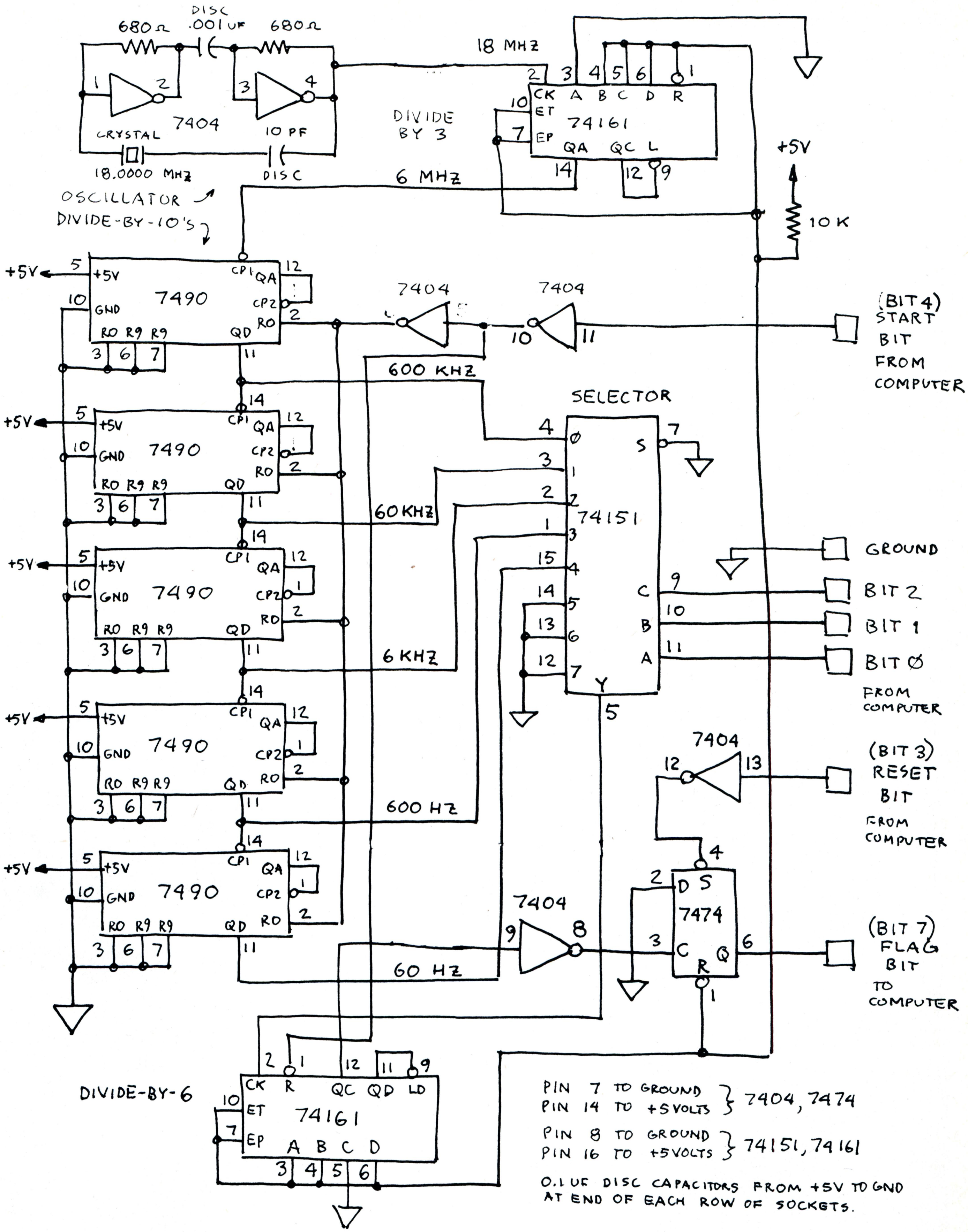
Successful product design requires that faults be converted into "features."

When the event occurs, the 7474 latch circuit notifies the computer by sending a signal on the flag bit (one of the bits of the parallel input port, here shown as bit 7). As soon as the computer takes cognizance of this fact, it can reset the flag bit by setting the reset bit (bit 3 on the parallel output port). The whole thing can be stopped or started by the start bit, another output bit (bit 4) which resets the divider chain when the computer says so.

It was originally intended that the real-time clock be usable to provide a 60-hertz time-base signal to the absolute-time clock in case the power line was not dependable. Halfway through the project, it became obvious that the use of the start bit would interrupt the 60-hertz count, and that this dual usage would be impossible.

Successful product design requires that faults be converted into "features," and the present case was no exception. Basing the divider chain on multiples of 60 hertz meant that 60 hertz such as could be obtained from the AC power line could be used to replace the 6-megahertz signal from the divide-by-three counter. Using this signal slows the clock down by a factor of 100,000, permitting delays of as long as 2.777

The designer in his lair redesigning

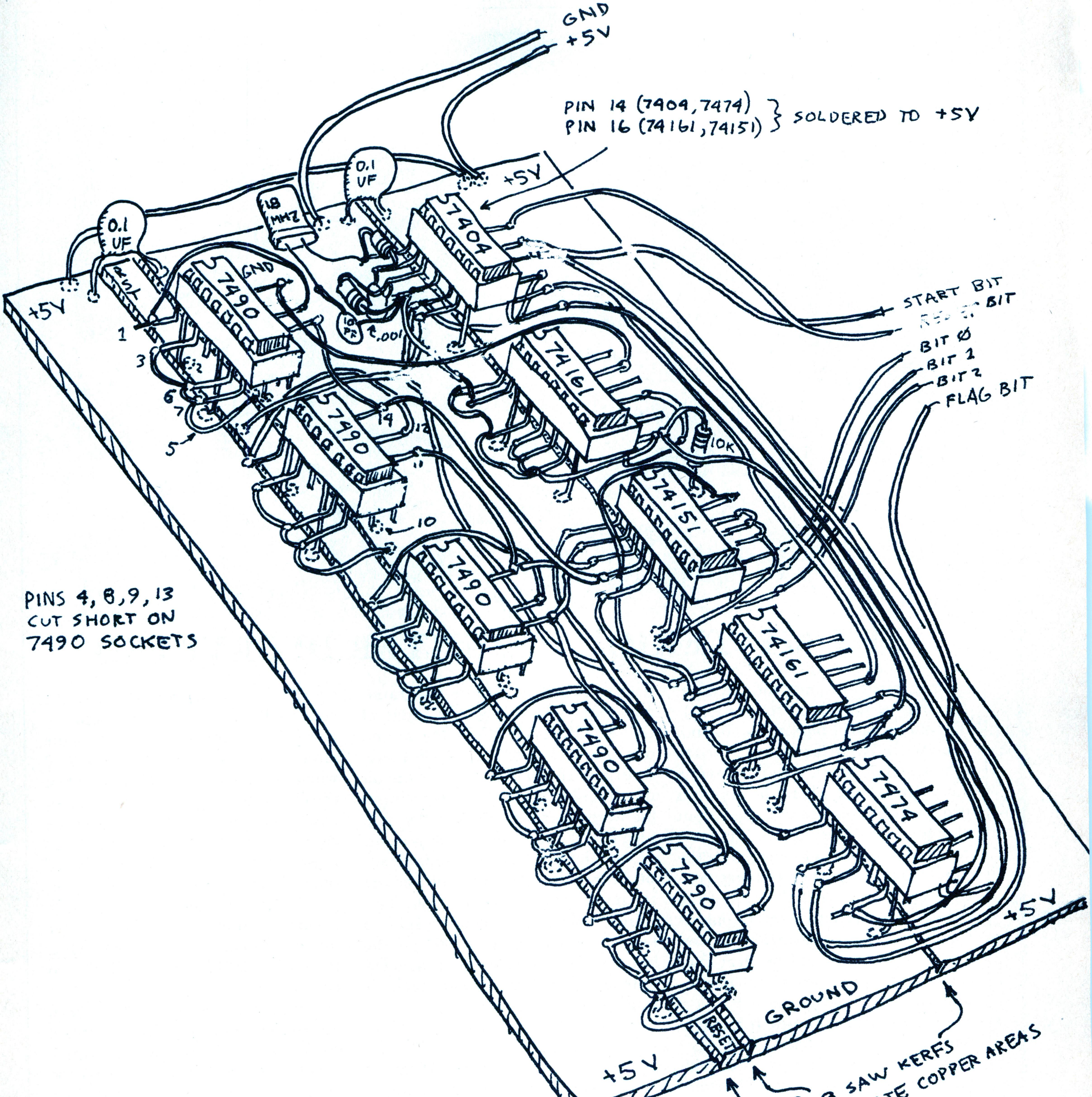

680Ω
DISC .001 UF
680Ω
18 MHZ
7404
CRYSTAL
10 PF
18.0000 MHZ
DISC
OSCILLATOR
DIVIDE-BY-10'S
DIVIDE BY 3
74161
CK A B C D R
ET EP QA QC L
6 MHZ
+5V
10 K
7490
+5V GND CP1 QA CP2 RO QD RO R9 R9
7404
7404
(BIT 4) START BIT FROM COMPUTER
600 KHZ
SELECTOR
74151
S Y C B A
60 KHZ
6 KHZ
600 HZ
60 HZ
GROUND
BIT 2
BIT 1
BIT Ø
FROM COMPUTER
7404
(BIT 3) RESET BIT FROM COMPUTER
7474
D S C R Q
(BIT 7) FLAG BIT TO COMPUTER
DIVIDE-BY-6
74161
CK R QC QD LD ET EP A B C D

PIN 7 TO GROUND
PIN 14 TO +5 VOLTS } 7404, 7474

PIN 8 TO GROUND
PIN 16 TO +5 VOLTS } 74151, 74161

0.1 UF DISC CAPACITORS FROM +5V TO GND AT END OF EACH ROW OF SOCKETS.

SCHEMATIC - REAL-TIME CLOCK L.FELSENSTEIN '78


GND
+5V
0.1 UF
0.1 UF
18 MHZ
+5V
7404
RESET
+5V
7490
GND
1
3
6
7
5
10 PF
.001
14
12
11
10
74161
10K
74151
7490
7490
74161
7490
7474
7490
START BIT
RESET BIT
BIT 0
BIT 1
BIT 2
FLAG BIT
+5V
GROUND
RESET
+5V

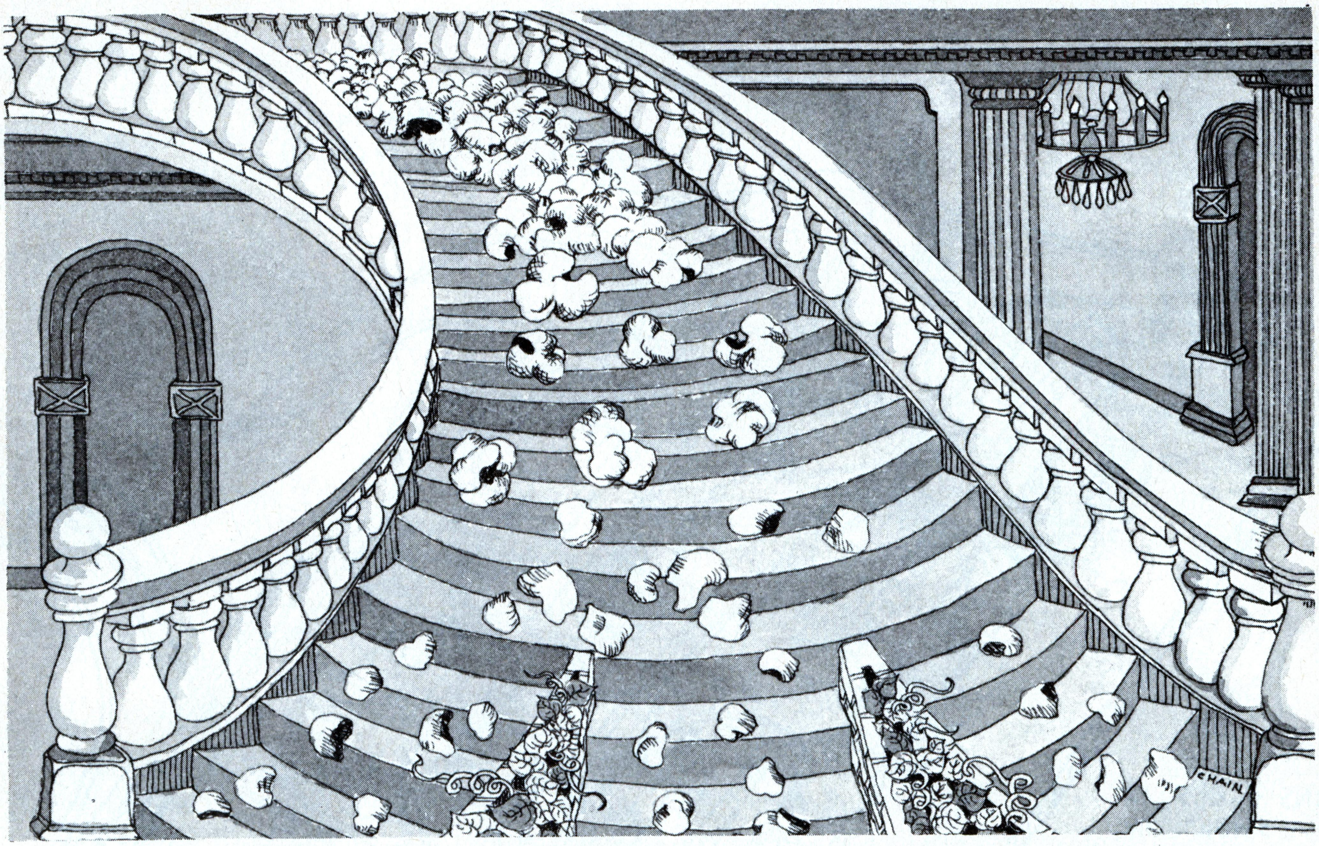
PIN 14 (7404, 7474)
PIN 16 (74161, 74151) } SOLDERED TO +5V

PINS 4, 8, 9, 13
CUT SHORT ON
7490 SOCKETS

3 SAW KERFS
TO SEPARATE COPPER AREAS

L. FELSENSTEIN '78

PICTORIAL DIAGRAM - REAL-TIME CLOCK



THE MYSTERIOUS COUNTER DECRYPTED

Imagine a black box, with an input and output (electrical connections). The output can be high or low, but not in between. When the input is raised to a high voltage level, the output stays where it is, but when the input is dropped from high to low, the output changes to its other level. Present a continuous stream of changes on the input, and the output changes continuously, but at half the rate of the input. Since all changes on the output require a change in a single direction on the input, it should be clear that this circuit "throws away" the low-to-high input transitions.

Such a circuit is known as a toggle circuit, and it is the basis for all electronic counters. Connect two such circuits, the output of the first one feeding the input of the second, and assume that they are both set to low (or zero). On the first input high-to-low transition, the first circuit sets to high, but the second one doesn't change. Using 1s and 0s, we can say the two devices are not at 01 (the right-hand number represents the first device). On the next input high-to-low transition, the first device sets back to 0, but the high-to-low transition thus generated at the input of the second device causes the second one to set to 1. The two toggles therefore sit at 10. Note that this is the binary number for 2. One more input high-to-low transition sets the first toggle to 1, and the circuit presents 11, or binary 3. The next input transition (high-to-low, as always) causes the input toggle to switch to 0. This switch causes the second toggle to switch, and the result is 00. (If the input of a third toggle were connected to the output of the second toggle, it would switch at this time.)

High-to-Low Transition	Second Circuit	First Circuit
Zero (initial)	0	0
First	0	1
Second	1	0
Third	1	1
Fourth	0	0

By connecting a series of toggles, a binary counter which keeps count of input transitions can be created. If we string four toggles together, the count will proceed to sixteen before it resets. It's no great trick to add some circuitry to reset the toggles to 0000 when the count reaches ten. Then the circuit has a cycle, or modulus, of ten, and presents a binary code equivalent to the decimal number of input transitions. Line up several of these counters, and each one can represent a decimal digit in a large decimal number. This is much easier for people to understand than binary. It's called BCD, or Binary Coded Decimal.

The type of counter we have been describing, with toggles connected one to the other, is known as a ripple counter. Since each toggle kicks the next one down, there is a slight delay between one bit's changes and the next bit's change. If enough counters are lined up (there are a total of twenty toggles in the real-time clock divider chain), the last bit may not get to change until after the first bit has already changed again. This places limits on the usefulness of ripple counters, although they are widely used because of their low cost. ▼

hours (10,000 seconds) and thus broadening its possible applications.

A real-time clock can be built using the by-now-familiar "scored laminate" ROMtechnique (see "Project Prometheus: Going Solar with Your Micro" and "The Absolute-Time Clock," in the November 1977 and the March-April 1978 issues, respectively), in which a base of copper-coated fiberglass is divided into sections by shallow grooves made with a hacksaw. In this case a very narrow area (less than 0.300 inch in width) is left under the 7490 sockets as a signal line carrying the reset signal. Pins soldered to this line add to the stability of the sockets.

Wirewrap sockets (fourteen-pin sockets for 7490, 7404, and 7474, and sixteen-pin sockets for 74151 and 74161) are used, with most of the pins bent outwards about 0.1 inch down from the body of the socket. Pins to be soldered to the base copper are bent only at the tips. These are pins 7 and 14 of the 7404 and 7474 sockets, pins 8 and 16 of the 71515 and 74161 sockets, and pins 5 and 10 of the 7490 sockets. Bend the tips of these pins outward. On the 7490 sockets, bend the tips of pin 2 inward. Cut short pins 4, 8, 9, and 13 on the 7490 sockets, pin 5 on the 7474 socket, and pin 6 on the 74151 socket. Bend outwards the tips of pin 2 on the 7474 socket, pin 5 on one 74161 socket, pin 3 on the other 74161 socket, and pin 7 on the 74151 socket.

Counter circuits play hopscotch to the beat of the signal fed them.

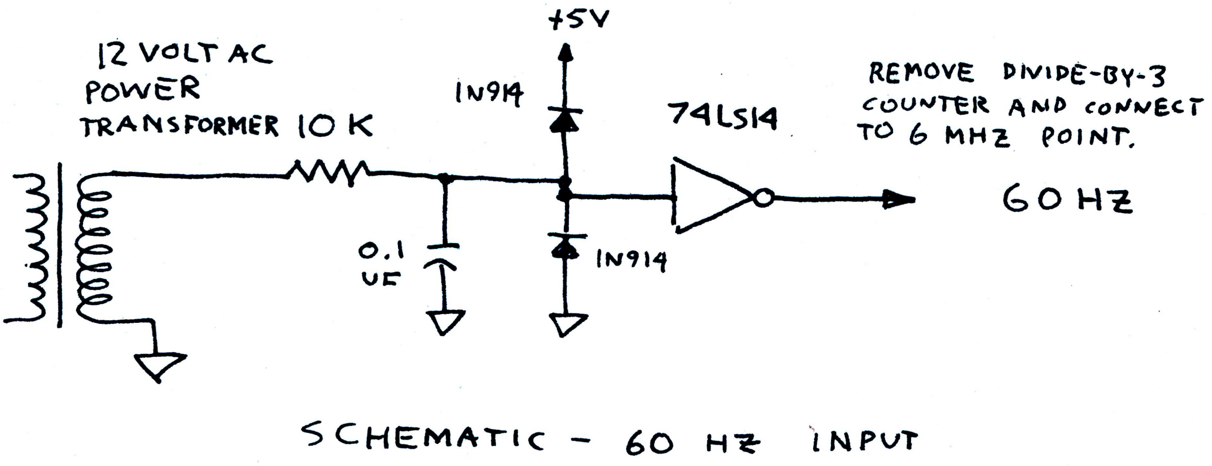
Forget about asking your computer to use its judgment, it hasn't got any.

Solder the 680-ohm resistors, the 0.001-microfarad and 10-picofarad disk capacitors, and the crystal to the 7404 socket before installing that socket on the board. Make sure that no short circuits exist between the leads of these components after the board is finished. On the 7490 sockets, prewire pins 1 to 12 and pins 3, 6, and 7 to pin 10 before installing them. This will greatly simplify construction. Use any solid wire, 24 gauge or smaller, to make the interconnections. Don't forget to connect the two 5-volt base areas together.

In operation, the circuit will do nothing until the start bit (bit 4) is at a low level (in this case a low level means less than 0.8 volt, a high level means between 2.4 and 5.0 volts). When that happens, the count selected by the number present on bits 0, 1, and 2 will be fed to the divide-by-six circuit. The numbers inside the rectangle symbolizing the 74151 on the schematic diagram represent the code on bits 0, 1, and 2 which will connect the various frequencies to the divide-by-six. (The code numbered 2, for example, connects the 6-kilohertz signal for an output frequency of 1 kilohertz, or a period of one millisecond.) Note that codes 5, 6, and 7 will send no frequency to the divide-by-six, so the circuit will not respond if those codes are presented.

If the reset bit (bit 3) is low, the flag will be set when the selected time has elapsed. The flag bit (bit 7) will then go to a high level, and the circuit will go on counting. When the computer takes notice of the flag bit, it should set the reset bit to a high level and then immediately drop it again, thus resetting the flag bit. When doing the programming, be careful to maintain the same values on the other bits while the reset bit is changed. Otherwise, time might suddenly stand still! ▼

The Absolute-Time Clock Addition For Producing a 60-Hertz Input For Your Real-Time Clock


+5V
12 VOLT AC POWER TRANSFORMER
10 K
1N914
74LS14
REMOVE DIVIDE-BY-3 COUNTER AND CONNECT TO 6 MHZ POINT.
60 HZ
0.1 UF
1N914
SCHEMATIC - 60 HZ INPUT

The schematic shown here takes advantage of an unused section of the 74LS04 in the absolute-time clock (*ROM* March-April 1978) by replacing the 74LS04 with a 74LS14. *Note: Do not replace the 7404 on the real-time clock with a 74LS14.* The oscillator will not work.

Missionary Position

by

Theodor Nelson

PROSPECTIVE EXTERNALS

Each of us has a dream.
What should computer technology
do for mankind?
This is my dream.
You may note that it seems to be
coming closer.
What follows may be thought of
as a first offical
public announcement.

The following specifications are presented for general comment prior to being frozen for implementation.

The Xanadu Hypertext Network has been designed as a universal publication system to make written material of all kinds instantly available electronically.

The principal purposes of this enterprise are to provide a universal system for electronic publication and to assure the rapid availability of writings in general and of our literary and historical heritage. We further intend to assure standardization, and most especially to set a level of performance from which no one may accidentally or purposely retreat.

Readers, authors, researchers, browsers, and publishers will all find certain of their needs met. The network is intended as well to be a powerful environment for private and unguided study of any subject. It is also intended as a general archival repository, and can function directly as a teleconferencing and electronic mail system.

CONVENTION 1. TYPES OF DOCUMENTS

A document consists of any text and/or links that someone wishes to store.

Thus the Gettysburg Address is a document, "Jabberwocky" is a document, and a set of links between them is a separate document.

A document may also consist of changes to another document. Thus the modified Gettysburg Address published in *MAD* by Doodles Weaver may be thought of as two documents: the original, and the changes.

The integrity of each document is maintained by these separations; derivative documents are permanently defined in terms of the originals and the changes. Evolutionary continuity is unambiguous and storage space is saved.

CONVENTION 2. OWNERSHIP, CONTROL, ROYALTY

Ancient and public-domain documents have no owner. Otherwise, each document has an owner who controls it and receives royalties for its use.

The owner determines whether a document is to be private or not.

The owner does *not* determine whether a reader may create links to it or modified versions of it.

The owner receives a royalty based upon use: especially, a royalty rate based upon the length of time his document is on a reader's screen. If it is on a screen for one hour, he receives a full hour's royalty. If it is on the screen for half an hour, or on half the screen for one hour, he receives half the hour's royalty. (Note that "on the screen" may for practical purposes be interpreted as *in the final buffer area.*)

If a modified document is read, the original owner and the modifier split the royalty in proportion to the size of the changes, as determined automatically.

A uniform royalty for all authors and documents is desirable, since this means there is no pretext for the system's keeping track of who reads what.

A one-time royalty is to be paid if a paper copy is made.

CONVENTION 3. LEVELS OF PUBLICATION

A document may be *private or published.* A private document may be read and linked-to only by the owner and his associates. A published document is available to anyone, and may be read and linked-to by anyone.

The name and author of a published document are listed in various directories, which are themselves published documents.

A published document may not be withdrawn from publication. Its owner may publish a modified version, with a request not to use the previous version, but the previous version remains published.

A document at an intermediate level, the *open* document, is generally available but not listed in directories.

CONVENTION 4. TYPES OF LINKAGE

Links are made by individuals as pathways for the reader's exploration; thus they are parts or modifications of the actual text. Links may be created within or between documents.

Any type of linkage is possible in principle. We are presently concentrating on three of basically literary origin:

¶ *The jump-link.* As symbolized by the asterisk, this generalizes the footnote.

¶ *The quote-window.* This allows one document to quote another, with the reader at once free to peruse the document of origin.

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OF THE XANADU HYPERTEXT NETWORK

¶ *Collateration.* This sets parts of two documents in correspondence to one another, permitting recognition and close study of the corresponding parts.

Collateration between successor versions of a document is automatic.

CONVENTION 5. FUNDING AND ACCESS

An hourly base rate is charged to all users.

This includes the cost of fetching all materials, the cost of all editing operations, and the hourly royalty to be divided among authors.

It also includes the placing in archival storage of all that a normal user can type in one hour.

This archival storage is comparatively slow to retrieve, involving minutes rather than seconds.

Storage at a more accessible level, or at more than one main station, involves additional storage charges. Thus a "publisher" is someone who pays for the rapid accessibility of materials and benefits from their use along with the author.

SYSTEM INTERNALS

The external specifications discussed are made possible only by certain technical developments which are for the present proprietary and secret. A number of radical discoveries in the field of computer indexing and retrieval render it possible to offer these services within seconds on configurations of present-day equipment, even as the number of documents and service requests expands to astronomical figures.

OTHER MATTERS

The network will not monitor who reads what or who writes what. Movement of text in the network will be under the dispersed control of user requests, with no central list of what is currently being read.

The network is to be a distributed system of storage and local services, with high-speed lines connecting the storage centers. Each main station is to have a number of functions:

¶ *Local service* to local user terminals, honoring local requests or passing them on to other main stations.

¶ *Local storage* of materials owned by local users and materials having high usage at this locality.

¶ *Pass-through* of requests and materials from other main stations to local users or other main stations.

¶ *Assigned storage:* duties of archival and repository storage as assigned within the system.

The Xanadu Information System consists of the Xanadu Hypertext Network used in conjunction with an official Xanadu Information Terminal. This and other trademarks will be available under nominal license fees to vendors offering compatible equipment, as precisely defined under specifications to be released at a later time and subject to phased change.

Studies are underway as to the best feasible organization for both system security and general economic incentive. Dispersed private-sector financing is foreseen, with probable use of the franchising mechanism. While the profit motive is necessarily involved—the profit motives of many firms and individuals must be enlisted—the ultimate goal is plain, idealistic, and simple.

OTHER ISSUES

A number of thorny issues, and their relation to these designs, remain to be discussed. These include system-level encryptions, libel, copyright infringement, "national security," hardening of the archives against war or disaster, and the general issue-cluster relating to privacy, withdrawability, and the financing of archival keepage.

Ted Nelson
PROJECT XANADU
Box 128,
Swarthmore, PA 19081

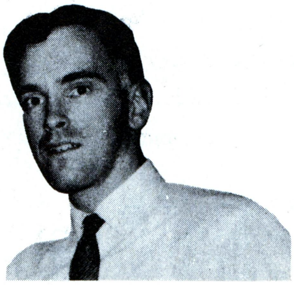
Your comments are invited.

We regret that there is little opportunity to answer correspondence.
If there is sufficient interest, a convention may be held later this year
to discuss these matters. If you would come, please so indicate.

Note: "Xanadu Information System,"
"Xanadu Hypertext Network,"
"Xanadu Information Terminal,"
"Lightning Literature,"
and the "Eternal-Flaming-X Symbol"
are trade and service marks
for products and services
offered by Theodor H. Nelson.

Cryptic Computer

TRANSPOSITION CIPHERS



by Frederick W. Chesson

Transposition ciphers are historically as old as substitution ciphers, if not as well known to those interested in cryptography. Although the first recorded use of transposition ciphers is clouded by the mists of antiquity, it appears to be substantiated through repetition in the history of classical Greece.

Tradition tells of the Spartan general, Lysander, who had achieved a victory over rival Athens in the protracted Peloponnesian War. Isolated in distant Sestos, Lysander grew increasingly concerned with the lack of communications from home, knowing all too well the intriguing of those who, jealous of his conquests, would stop at nothing to discredit him in the eyes of the ruling class.

Finally a slave arrived, the only one of four who had set out through unfriendly territory. His openly carried message tablet merely commanded Lysander to observe a religious ritual to appease the gods. The General considered this message, then requested the messanger's ornate cloth belt, and retired to his private quarters. There, he detached the club-like baton or *scytale,* which was his badge of office, from his own belt and wound the slave's belt helix-wise about it. A jumble of letters on the belt, apparently an incantation from a local priest to guard the traveler, suddenly resolved themselves into coherent lines of writing. After reading an ominous warning of treachery at home, Lysander set sail on the fastest galley at his disposal. (If he had penned a reply before his departure, he would have first wound a blank strip of cloth about his own scytale, making sure that the intended recipient would have a baton of the same diameter!)

Much more familiar to us are anagram-like arrangements of letters or even complete words, written into boxes or rectangles according to a predetermined key. The message *TEN PRINTED CIRCUIT BOARDS WILL BE REMOVED,* which contains thirty-six letters, can be written into a six-by-six square (a four-by-four rectangle is also feasible) and then taken out by a variety of routes, as shown below.

	1	2	3	4	5	6
1	*T*	*E*	*N*	*P*	*R*	*I*
2	*N*	*T*	*E*	*D*	*C*	*I*
3	*R*	*C*	*U*	*I*	*T*	*B*
4	*O*	*A*	*R*	*D*	*S*	*W*
5	*I*	*L*	*L*	*B*	*E*	*R*
6	*E*	*M*	*O*	*V*	*E*	*D*

Route 1: Straight take-off by descending columns.
Cryptogram: *TNROI EETCA LMNEU LROPD IDBVR CTSEE IIBWR D.*

Route 2: Straight take-off by ascending columns.
Cryptogram: *EIORN TMLAC TEOLR UENVB DIDPE ESTCR DRWBI I.*

Route 3: Alternating columns.
Cryptogram: *TNROI EMLAC TENEU RLOVB DIDPE ESTCR IIBWR D.*

Route 4: Diagonals, from upper left corner.
Cryptogram: *IRIPC BNDTW EEISR TTUDE DNCRB ERALV OLOIM E.*

Other geometric take-off routes will suggest themselves, including such multiple operations as taking the text out a spiral route into a second square or rectangle, and taking the text out via vertical or horizontal strips.

If the rows and columns of the block are keyed, a new element of security is afforded. If the preceding message were keyed by a mixed sequence of 4-1-5-3-6-2 for the columns and 3-1-4-6-2-5 for the rows, first the message would be taken out by one of the keys into another box of the same size and transcribed with the second key.

	4	1	5	3	6	2
3	*T*	*E*	*N*	*P*	*R*	*I*
1	*N*	*T*	*E*	*D*	*C*	*I*
4	*R*	*C*	*U*	*I*	*T*	*B*
6	*O*	*A*	*R*	*D*	*S*	*W*
2	*I*	*L*	*L*	*B*	*E*	*R*
5	*E*	*M*	*O*	*V*	*E*	*D*

First transposition:

3	*E*	*I*	*P*	*T*	*N*	*R*
1	*T*	*I*	*D*	*N*	*E*	*C*
4	*C*	*B*	*I*	*R*	*U*	*T*
6	*A*	*W*	*D*	*O*	*R*	*S*
2	*L*	*R*	*B*	*I*	*L*	*E*
5	*M*	*D*	*V*	*E*	*O*	*E*

Second transposition:

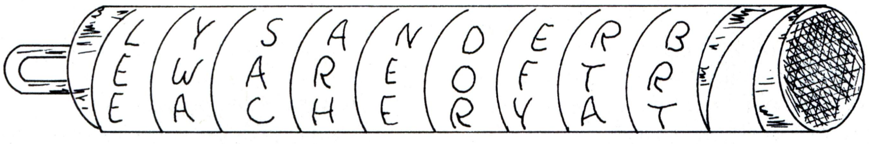
TIDNE CLRBI LEEIP TNRCB IRUTM DVEOE AWDOR S.

For more information on these and other letter-transposition ciphers, I would recommend the books listed in Further Reading.

Cryptanalysis of transposition cipher systems depends first on identification. A *frequency count* will disclose whether such letters like *E, T, A, O, I,* and *N* are present in normally expected quantities. The appearance of *X*s or *Z*s among a standard frequency distribution may indicate their use as word separators, a fact which may actually assist in breaking the cryptogram.

Multiple anagramming, when two or more messages are suspected of having been enciphered by the same system, is very useful and lends itself to computer techniques, where identical portions of each message are displayed or printed out.

Even for the single message, the technique is similar. The display program causes sequentially separated letters to be compared for "goodness of fit." For instance, the first and twelfth letters are paired up with the second and thirteenth, followed by the third and fourteenth, and so on. An interactive program may allow keyboard manipulation to shift various lines of text against each other until digrams of high probability begin to show up in relevant numbers. This is illustrated below in vertical alignments, but may also be done horizontally on the computer display or printer.


L Y S A N D E R B
E W A R E O F T R
E A C H E R Y A T

Lysander's Scytale (with message)

1	2	3
—H	*TH*	*T—*
TR	*ER*	*EH*
ES	*IS*	*IR*
ID	*ND*	*NS*
NN	*AN*	*AD*
AD	*ED*	*EN*
EP	*UP*	*UD*
UF	*OF*	*OP*
OE	*RE*	*RF*
RY	*BY*	*BE*
B—	*——*	*—Y*

While acceptable digram pairs can be found in all three alignments, only column 2 has an overall grouping of high-frequency digrams, starting with *TH,* the most common letter-pair of all.

Further Reading

Pratt, Fletcher. *Secret and Urgent.* Indianapolis, 1939. Prior to Kahn's *Code Breakers,* this was one of the major popular works on cryptology and still contains much useful information, including several transposition systems.

Plum, William R. *The Military Telegraph in the Civil War.* Chicago, 1882. (Reprinted recently by Arno Press of New York.) A two-volume work detailing Civil War telegraphy, including much on cryptography and a complete reproduction of the U.S.M.T. "Code Number Nine," used from 1862-1868.

Kahn, David. *The Code Breakers.* New York: Macmillian Co., 1967. This is probably the most definitive modern work on cryptology, covering both historical and technical aspects. See (in hardcover edition) chapters 9, 10, and 11 for cryptogram uses during World War I.

String manipulation and formatting is very convenient for the computer-assisted cryptanalyst to have, allowing almost instantaneous display of a message in a variety of formats, either sequentially or simultaneously. Programs may also be developed to check the distribution of vowels and consonants in each row of a trial decipherment. A good mix can indicate that the first transposition of a two-part system has been determined and the solution is at hand.

Letter trios (trigrams) and complete words can also be subjected to transposition. Word transposition has been traced as far back as the 1600s—the Duke of Argyle used this system in his abortive uprising against James II in 1685. With the arrival of the magnetic telegraph, the word transposition system was used mostly by journalists and others who could not carry around bulky code books.

Anson Stager, superintendent of Western Union's Western Division in Cleveland, Ohio, developed a version of transposition ciphers for Governor Dennison at the outbreak of the Civil War. Stager's version came to the attention of General George B. McClellan, who was then rising rapidly in the Union Army after a series of minor, but impressive, victories. Following the debacle at Bull Run near Manassas, Virginia on 21 July 1861, McClellan was appointed head of the Federal forces. He brought in Stager and his fellow telegraph engineer, Thomas T. Eckert, to develop a military-telegraph system. To encipher confidential messages, Stager and Eckert developed successfully more complex editions of the original transposition cipher. Routes of twelve columns and over twenty lines eventually appeared, together with increasingly comprehensive lists of code words covering such useful topics as time, dates, rivers, forts, generals, cities, and a whole lexicon of military terminology.

Even though telegraph lines were tapped and offices raided, the Confederates apparently never cracked any of the dozen or so code editions then in use. Intercepted telegrams were even reportedly published in Southern newspapers with appeals for civilian assistance at cryptanalysis. These stories, even if true, actually might have been clever "covers," in the event that the Richmond authorities solved the active U. S. Military Telegraph cipher.

Transposition ciphers continued in military service well into the twentieth century. In World War II, the Germans employed a double-transposition system, termed ÜBCHI by the French, who broke the system and others like it. (The cryptographic conflicts of World War I are well described by David Kahn in his book *The Code Breakers.*)

By World War II, cryptography had become quite mechanized, with the new technology favoring substitution systems. Transposition, however, was still serviceable for resistance groups, where pencil-and-paper techniques were a must in the shadowy world of the underground. French secret agent Jacque Bergier's book *Secret Weapons—Secret Agents* illustrates some of these techniques and includes the message that helped form the answer "No!" to Hitler's vengeful question: "Is Paris burning?"

Post-World War II cryptography relied on substitution systems, since the mechanical and electro-mechanical cipher machines of that era were oriented towards "linear processing" rather than the "batch-processing" concept associated with transposition. Modern computer techniques have followed this tradition, although they are, ironically, suited to batch processing as well. Today, pseudorandom techniques used for transposition ciphers can generate keys appropriate to any message length — the longer the message, the greater the security. (In contrast to the substitution ciphers, where brevity conceals the encoding technique.) For example, the following message is counted and a key stream appropriate to its length is generated accordingly:

DATA TRANSMISSION WILL RECOMMENCE
AT TWENTYTHREE THIRTY HOURS X

Key: 09-28-55-41-10-25-40-02-07-18-35-47-16-34-52-23-04-46-05-29. . . .

The message letters are then taken out according to this key and sent in the usual five-letter groups:

SNXRM MTAAI ERNWU CAITC. . . .

At the reception point, a count of the message letters or some message indicator causes the receiving terminal processor to look up or reconstruct the key and reassemble the message.

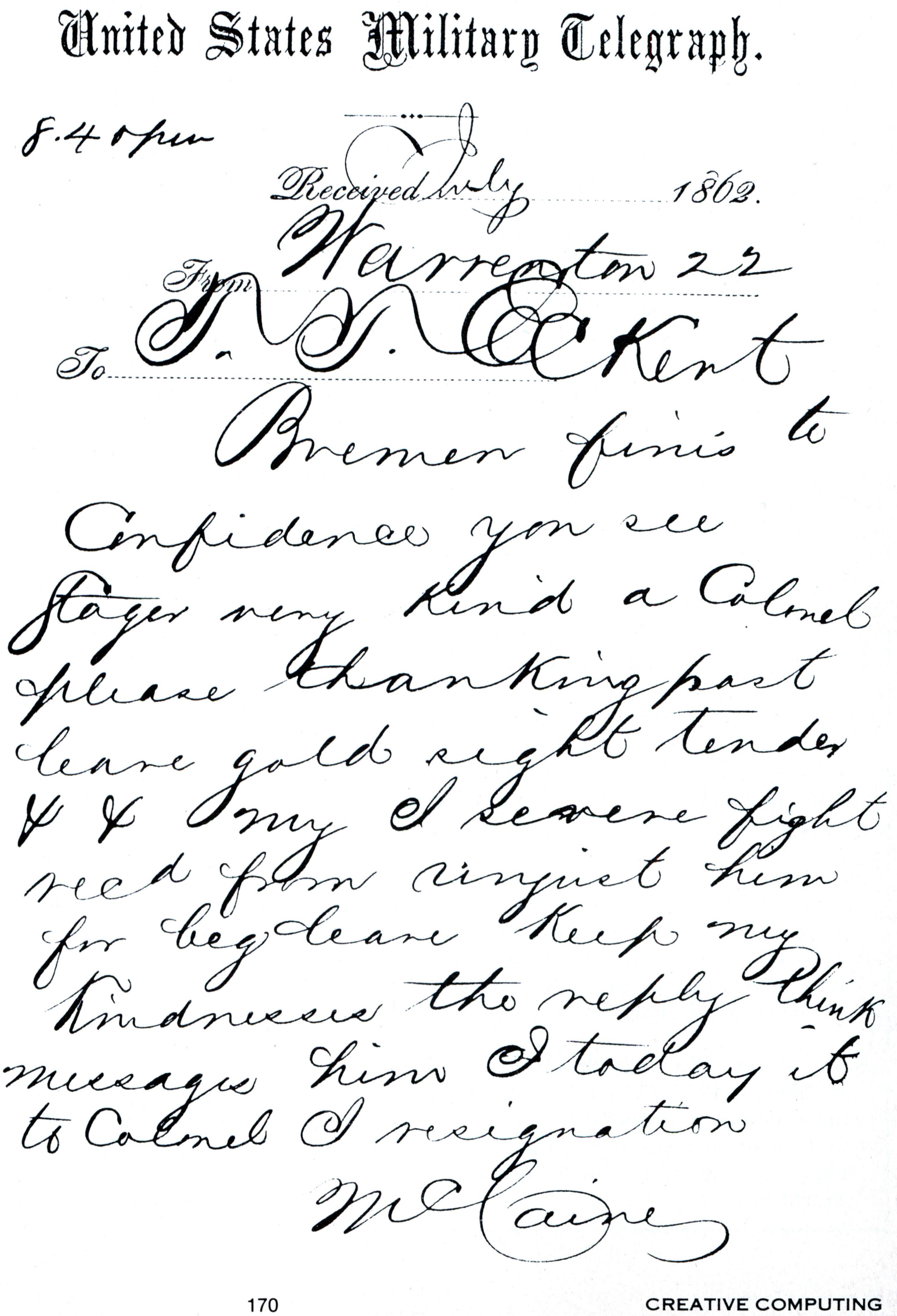
This technique would make an interesting and possibly useful project for the home computerist to program. It would also help keep the ancient art of transposition ciphers alive and healthy. ▼

This month's cryptogram:

For a challenge, we present an original U. S. Military Telegraph enciphered telegram, sent from Warrenton, Virginia on 22 July 1862 by an operator named R. R. McCaine from Seymour, Indiana. The text of the telegram involves a "personnel problem" in the U.S.M.T. To accomplish what Confederate cryptanalysts were apparently unable to do, write the message in strips reading both up and down and slide the strips against each other until coherent word pairs begin to emerge.

Hint:

There are more than five lines and five columns in the transposition, with null words used at the end of each column. The last word of the message is RESIGNATION. BREMEN is the key. Solution on page 124.



United States Military Telegraph.

8.40 pm

Received July 1862.

From Warrenton 22

To T. T. Eckert

Bremen finis to
Confidence you see
Stager very kind a Colonel
please thanking past
leave gold sight tender
& & my I severe fight
need from unjust him
for beg leave keep my
kindnesses the reply think
message him I today it
to Colonel I resignation

McCaine

AIQuotient

THEOREM PROVING

by Bryant W. York Edited by A. I. Karshmer

After several columns dealing with the high-level aspects of computer vision and robotics, we now turn to one of the most fundamental issues in all of Artificial Intelligence—theorem proving. All AI systems that attempt to understand the natural world rely on some form of mechanical theorem provers. For example, the vision system discussed in the January 1978 column was designed to include a mechanical theorem prover to aid in understanding the natural world through its data base.

This month's column, by Bryant W. York of the University of Massachusetts, lays the basic groundwork for understanding symbolic logic and mechanical theorem proving. The author presents the subject in more formal terms than we have used in the past because this is the most straightforward method of presenting the material. The article presents a basic introduction of logic and a treatment of propositional calculus. The subject of first-order predicate calculus will be presented in a future column.

All men are mortals.
Socrates is a man.
Therefore, Socrates is a mortal.

> ***Theorem provers could easily be done on a hobbyist computer and used for such things as playing the Wff 'n' Proof games.***

Almost everyone has seen a syllogism like the one above at some time in his life. It is merely a means of inferring a new fact from facts which are given, and it plays an important role in the early development of our "logical reasoning." The syllogism is an example of a "totally syntactic" means of deducing a new fact from certain known facts. By totally syntactic I mean that only the "form" of the given facts is important in order to make the deduction, not the meaning or interpretation of the facts. For example, after seeing a few syllogisms most people arrive at the following general rule of inference:

All X are Y
Z is an X
Therefore, Z is a Y

This rule is totally syntactic in the sense that it is independent of the meanings of X, Y, and Z. And it is this syntactic nature of our rules of inference which led researchers to believe that logical reasoning could be mechanized—specified in an algorithm for use in computers. Such research falls into that branch of AI referred to as "mechanical theorem proving."

Mechanical theorem proving is an area of AI which requires a certain amount of mathematical sophistication for complete understanding; however, my goal in this article is to present some of the key ideas without putting severe mathematical demands upon the reader. For this reason, I have limited my discussion to "propositional logic" and what "theorem proving" means within that logic.

There are several different types of logic, or forms of representing facts and their reasonings. The simplest type of logic is "propositional logic" (sometimes referred to as propositional calculus). The basic element of propositional logic is the "proposition" which is merely a declarative sentence. Propositions have the property that they may be either true or false, but *not* both. An example of a true proposition is the statement "Snow is white."

Table 1
Logic Connectives

$\sim G$	not G
$G \wedge H$	G *and* H
$G \vee H$	G *or* H
$G \rightarrow H$	G *implies* H
$G \leftrightarrow H$	(G *implies* H) *and* (H *implies* G)

Propositions may be combined with other propositions through the use of logical connectives to form *wffs.* (A wff is an abbreviation for "well-formed formula.") At this point, you may think of a wff as merely a compound statement such as "Snow is white and grass is green." In this particular statement, the wff consists of two separate propositions joined by the binary logical connective *and.* And is called a binary connective because it joins *two* propositions. Another way in which to form a wff is to negate a proposition—given the proposition "Snow is white," its negation is the wff "Snow is *not* white." Negation is called a unary connective, because it acts on a single proposition. In propositional logic there are sixteen binary connectives and only one unary connective.

Propositional logic very precisely defines how wffs are formed and evaluated in terms of truth and falsehood. These rules can be specified more compactly if we introduce some shorthand terms for representing propositions and connectives. Since propositions are atomic elements in propositional logic (we are not concerned here with their internal structure), they may be represented by single symbols such as F, G, H, and so on. Since we are concerned only with their truth or falsity, we may associate a T or F with each proposition. The standard symbols for the basic logical connectives are shown in table 1.

A Great
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At A Fabulous
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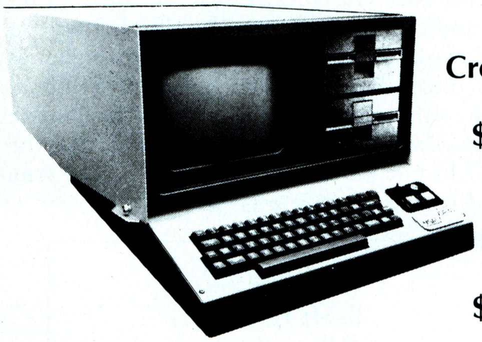
From Computer
Enterprises:

The VDP-40
Video Data Processor



Credit Card
Price:
$4207.00

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Price:
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Designed for the office or for the home, the IMSAI Video Data Processor, the VDP-40, places a microcomputer well within the budget of the average small businessman or systems developer. The VDP-40 may be used to computerize the accounting and inventory functions of a small business. The VDP-40 can communicate to additional VDP-40s or other 8080/85-based computers, and can act as a terminal in a data communications network.

The VDP-40 is a fully integrated system, featuring an 8085 microprocessor, 32K RAM memory, two 5¼-inch floppy disks, 9-inch CRT, heavy-duty power supply, professional keyboard, terminated/regulated motherboard, and serial and parallel I/O ports in a handsome cabinet.

The IMSAI VDP-40 comes fully assembled and tested. Built-in serial and parallel I/O ports provide the means to connect, via appropriate cabling, peripheral devices including line printers, modems and auxiliary terminals. Built-in expansion capability allows the user to increase the RAM, I/O ports and number of disk drives.

SYSTEMS FEATURES.
- Fully Integrated Computing System in a single Cabinet
- High Speed 8085 Processor
- 80 x 24 Video Display
- 5¼-inch Twin Floppy Disk Drives
- Integrated CRT Display
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In propositional logic, a wff is recursively defined by a simple set of rules.

(1) A proposition is a wff.

(2) The negation of a wff is a wff.

(3) If F, G are wffs, then $F \land G$, $F \lor G$, $F \rightarrow G$, and $F \leftrightarrow G$ are wffs.

(4) All wffs are generated by application of the above rules.

The rules are defined in terms of the four basic binary connectives and the unary connective (the remaining twelve binary connectives may be expressed as combinations of the basic ones). Each logical connective has a special meaning, defined by its own truth table. The truth tables for each of the logical connectives may be found in any text on symbolic logic.

Now, in order to show how a simple theorem prover based upon propositional logic might be constructed, I must first give a few definitions and state two important theorems which make it possible to perform deductions. First, an *interpretation* of a wff is an assignment of truth values (true or false) to the propositions of the wff. For example, the assignment of such truth values as T to P, F to Q, T to R, and T to S in the wff $(P \land Q) \rightarrow (R \land (\sim S))$ is a particular interpretation of this wff. (Notice that, since there are four propositions (P, Q, R, S), there are $2^4 = 16$ interpretations of this wff.) Figure 1 is a truth table showing the truth value of this wff, containing each of the

Figure 1
Truth Table for Wff

	(P	∧	Q)	→	(R	∧	∼	S)
1	T	T	T	F	T	F	F	T
2	T	T	T	T	T	T	T	F
3	T	T	T	F	F	F	F	T
4	T	T	T	F	F	F	T	F
5	T	F	F	T	T	F	F	T
6	T	F	F	T	T	T	T	F
7	T	F	F	T	F	F	F	T
8	T	F	F	T	F	F	T	F
9	F	F	T	T	T	F	F	T
10	F	F	T	T	T	T	T	F
11	F	F	T	T	F	F	F	T
12	F	F	T	T	F	F	T	F
13	F	F	F	T	T	F	F	T
14	F	F	F	T	T	T	T	F
15	F	F	F	T	F	F	F	T
16	F	F	F	T	F	F	T	F

final truth value ———
intermediate evaluations ▬ ▬ ▬ ▬
evaluated first – – – – –

sixteen possible interpretations. This truth table shows that we can evaluate a wff with all its possible interpretations by evaluating in the proper order each of the subexpressions. Expressions within the deepest level of parentheses are evaluated first, and so on. Wff evaluators are very easy to write in recursive programming languages and are only slightly more difficult in languages without recursion. True and false may be represented by 1 and 0; "complement" (not), "and," and "exclusive or" generally exist as primitive operations in most digital computers. The four basic binary connectives may thus be written as functions of "and," "complement," and "exclusive or," or you may wish to store the truth table for each connective. At any rate, there are simple algorithms for evaluating a wff, given an assignment of truth values to the proposition in the wff.

Secondly, a wff is *valid* if and only if it is true under all interpretations. A wff is *inconsistent* (or unable to be satisfied) if and only if it is false under all interpretations. For instance, wff, G, is a *logical consequence* of wffs $F_1, F_2, \ldots F_n$ if and only if for any interpretation in which $F_1 \wedge F_2 \wedge \ldots \wedge F_n$ is true, then G is also true.

These definitions allow us to state one of the most important theorems of symbolic logic—the *deduction theorem:*

> Given wffs $F_1, F_2, \ldots F_n$ and a wff G, then G
> is a logical consequence of $F_1, F_2, \ldots F_n$ if
> and only if the wff $((F_1 \wedge F_2 \wedge \ldots \wedge F_n) \rightarrow G)$
> is valid.

An alternative formulation of this theorem, which better describes the proof procedure actually implemented in most mechanical theorem-proving systems, is:

> Given wffs $F_1, F_2, \ldots F_n$ and a wff G, then G
> is a logical consequence of $F_1, F_2, \ldots F_n$ if
> and only if the wff $((F_1 \wedge F_2 \wedge \ldots \wedge F_n) \wedge \sim G)$
> is inconsistent.

This latter theorem underlies the technique of proof by "refutation"—showing that the negation of the wff under question is inconsistent with the known facts. Note that the logical connective *and* is associative. This means that the wff $(F_1 \wedge F_2 \wedge F_3)$ is equivalent to the wff $((F_1 \wedge F_2) \wedge F_3)$ which in turn is equivalent to $(F_1 \wedge (F_2 \wedge F_3))$.

Let's see how this theorem might be used in a simple propositional theorem prover. Consider the following example:

Given the propositions
  P: the gun is fired
  Q: the person dies

Given the wffs (basic facts)
  F_1: if the gun is fired, then the person dies
    $(P \rightarrow Q)$
  F_2: the person does not die
    $(\sim Q)$

Deduce the wff G:
  the gun is not fired
    $(\sim P)$

The proof procedure consists of forming the new wff

> if the gun is fired, then the person dies, *and*
> the person does not die, *and*
> the gun is fired

represented by $F_1 \wedge F_2 \wedge \sim G)$ or $(((P \rightarrow Q) \wedge \sim Q) \wedge P)$ and then showing that this wff is inconsistent—false under all possible assignments of truth values to the propositions P, Q. Figure 2 shows the truth table for this wff; note that $\sim(\sim P)$ is equivalent to P.

Figure 2
Truth Table for
Wff

P	Q	$P \rightarrow Q$	$\sim Q$	$(P \rightarrow Q) \wedge \sim Q$	$(((P \rightarrow Q) \wedge \sim Q) \wedge P)$
T	T	T	F	F	F
T	F	F	T	F	F
F	T	T	F	F	F
F	F	T	T	T	F

Now, let's summarize what is required for a simple propositional logic theorem prover. First, you need a data structure in which to represent proposition symbols, a data structure for storing wffs, and a means of evaluating the basic logical connectives (either through function calls or table lookup). Next, you need a means of generating all the possible interpretations for a wff, and you need a wff evaluator to evaluate the wff under each interpretation. The proof procedure consists of conjoining the negation of the wff under question with the conjunction of wffs (basic facts) in the data base, evaluating the resulting wff, and testing the truth table for inconsistency. Such a theorem prover could easily be implemented on a hobbyist computer and used for such things as playing the *Wff 'n' Proof* games.

If the reader wishes to do larger problems involving more sophisticated logical reasoning, he will need not only a larger computer but also a more powerful logic. For example, the syllogism at the beginning of this article cannot be represented in propositional logic; it requires a logic with more powerful atomic symbols. This type of logic is called the "First-Order Logic" or the "First-Order Predicate Calculus." There are many mechanical theorem proving systems based on the first-order logic; however, a discussion of such systems will be dealt with in a future column.

Hopefully, this article has removed some of the mystique surrounding mechanical theorem proving and has introduced the reader to some of the important basic ideas of symbolic logic in a relatively painless way. ▼

Further Reading

Chang, Chin-Liang, and Lee, Richard Char-Tung. *Symbolic Logic and Mechanical Theorem Proving.* New York: Academic Press, 1973.

Allen, Layman E. *Wff 'N Proof: The Game of Modern Logic.* New Haven: Autotelic Instructional Materials Publishers, 1962.

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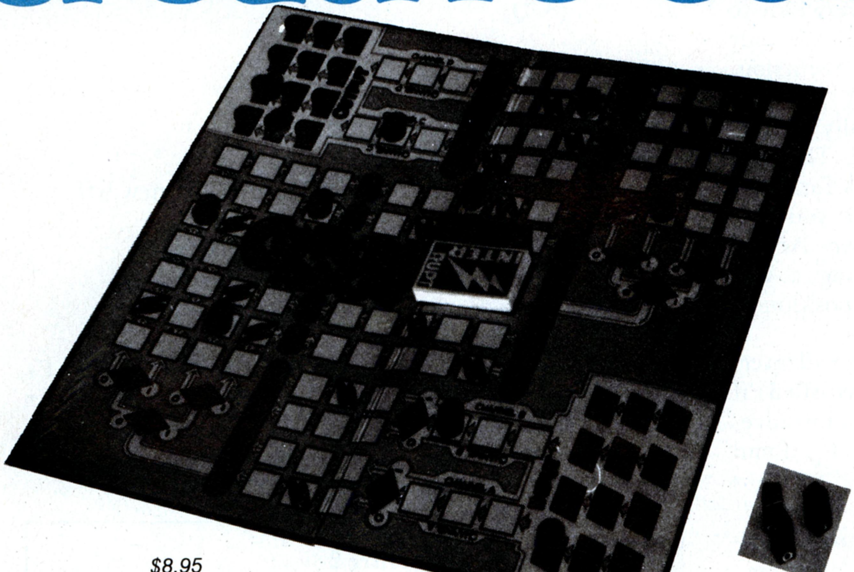

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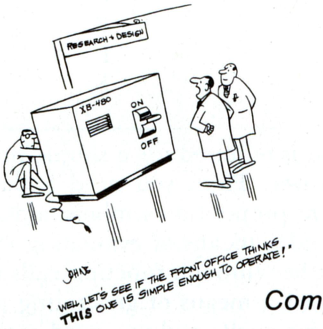
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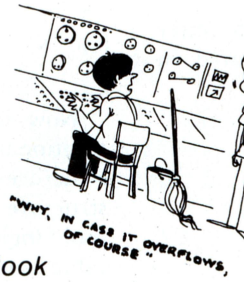
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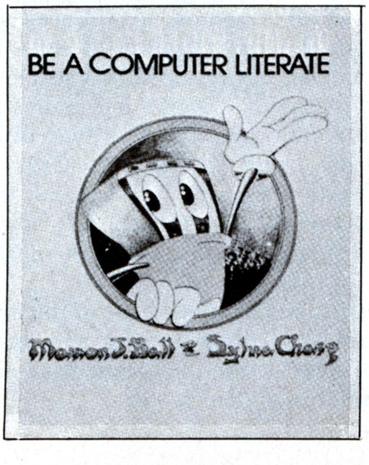
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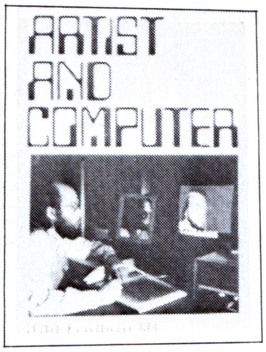

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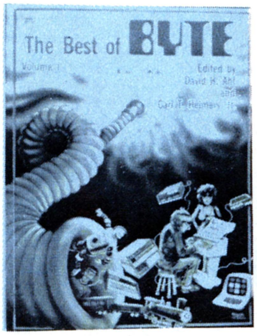

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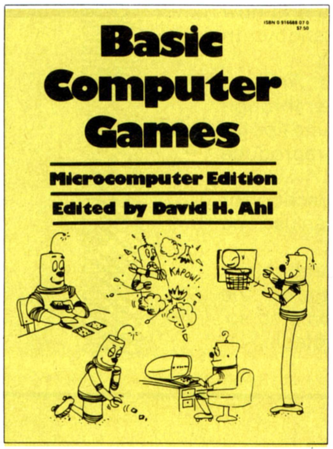

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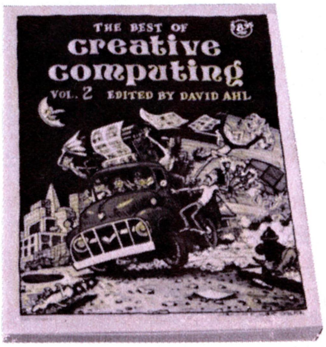

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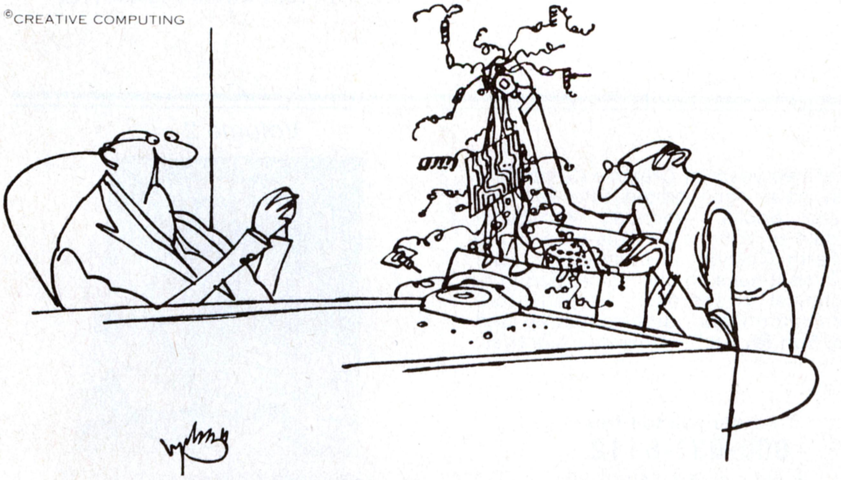

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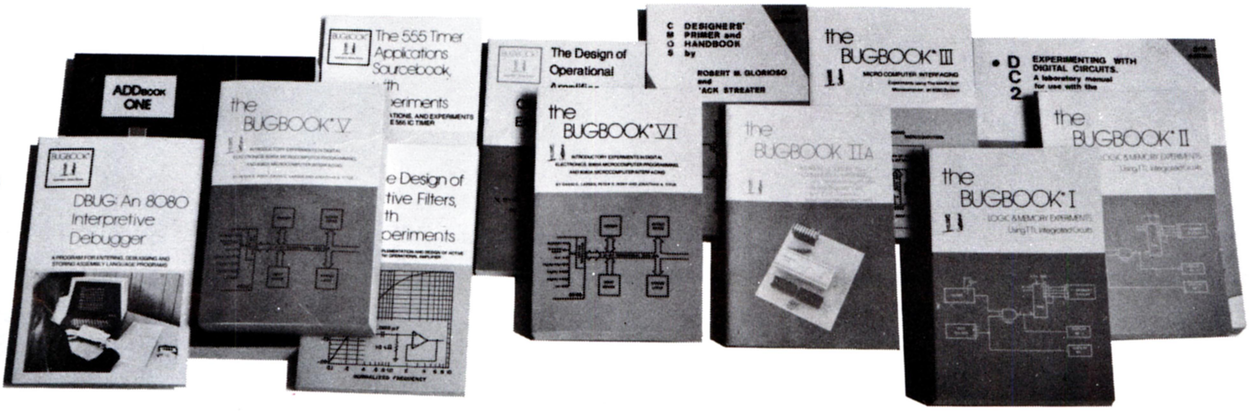
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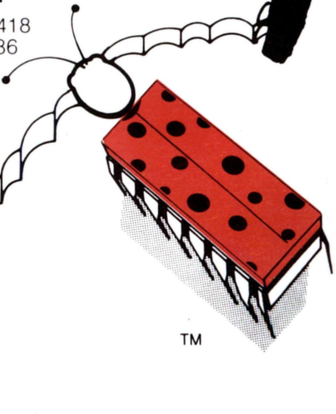

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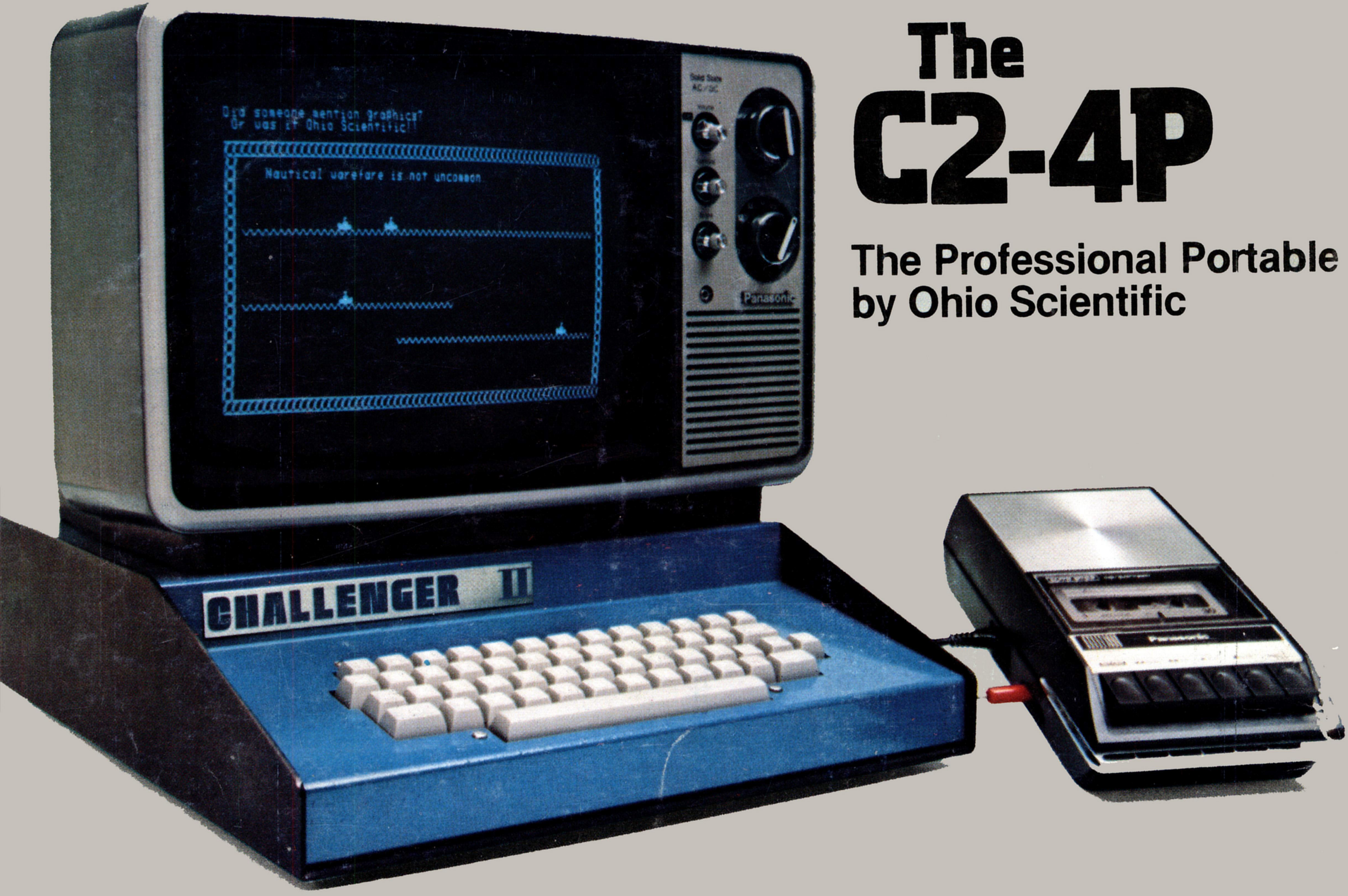

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